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MARCH, 1903.

HITHERTO UNPUBLISHED LETTERS OF CHARLES DARWIN.*

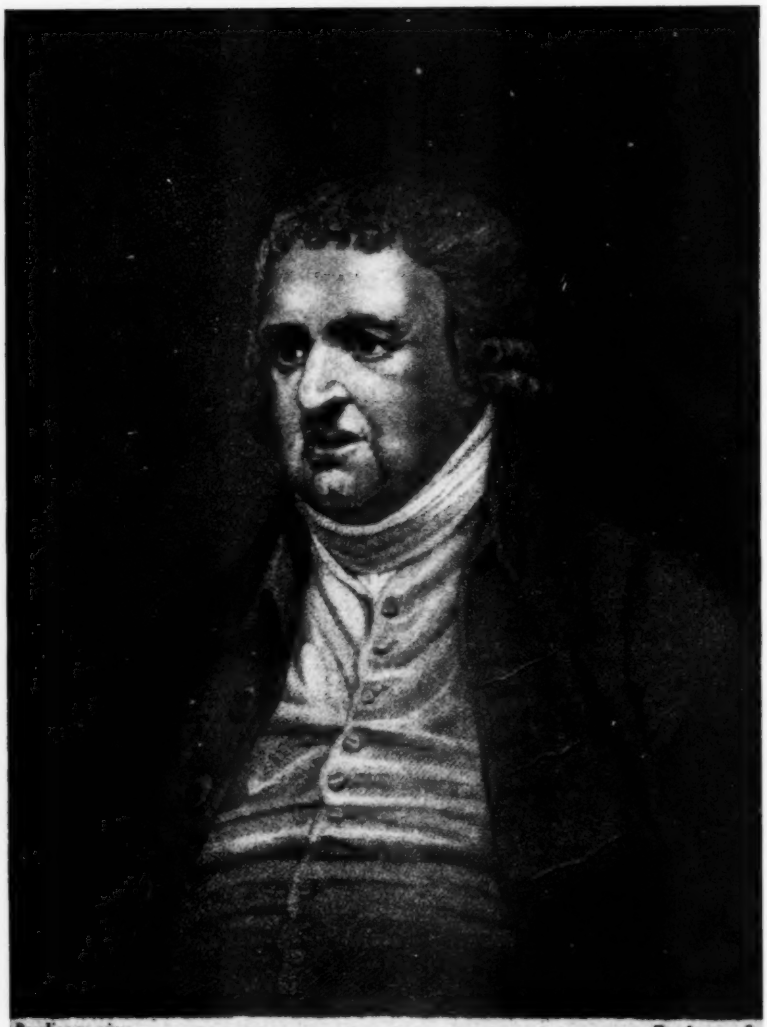
To A. R. WALLACE.

DOWN, April 6th, 1859.

I this morning received your pleasant and friendly note of November 30th. The first part of my MS.† is in Murray's hands to see if he likes to publish it. There is no preface, but a short introduction, which must be read by every one who reads my book. The second paragraph in the introduction I have had copied verbatim from my foul copy, and you will, I hope, think that I have fairly noticed your paper in the *Linn. Journal.* You must remember that I am now publishing only an abstract, and I give no references. I shall, of course, allude to your paper on distribution; and I have added that I know from correspondence that your explanation of your law is the same as that which I offer. You are right, that I came to the conclusion that selection was the principle of change from the study of domesticated productions; and then, reading Malthus, I saw at once how to apply this principle. Geographical distribution and geological relations of extinct to recent inhabitants of South America

* 'The Life and Letters of Charles Darwin,' edited by his son, Professor Francis Darwin, and published in this country in 1887 by Messrs. D. Appleton and Company, is not surpassed in interest by any similar records, and for the man of science it is of unparalleled importance. From unused material and additional letters, Professor Francis Darwin and Mr. A. C. Seward have compiled a second series, entitled 'More Letters of Charles Darwin: A record of his work in a series of hitherto unpublished letters,' which will be published shortly in two volumes by Messrs. D. Appleton and Company. By their courtesy we are enabled to print here a number of letters which show the surpassing interest of the work.—EDITOR.

† 'Origin of Species.'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Erasmus Darwin. M.D.

first led me to the subject: especially the case of the Galapagos Islands. I hope to go to press in the early part of next month. It will be a small volume of about five hundred pages or so. I will of course send you a copy. I forget whether I told you that Hooker, who is our best British botanist and perhaps the best in the world, is a full convert, and is now going immediately to publish his confession of faith; and I expect daily to see proof-sheets. Huxley is changed, and believes in mutation of species: whether a convert to us, I do not quite know. We shall live to see all the younger men converts. My neighbour and an excellent naturalist, J. Lubbock, is an enthusiastic convert. I see that you are doing great work in the Archipelago; and most heartily do I sympathise with you. For God's sake take care of your health. There have been few such noble labourers in the cause of Natural Science as you are.

P. S. You cannot tell how I admire your spirit, in the manner in which you have taken all that was done about publishing all our papers. I had actually written a letter to you, stating that I would not publish anything before you had published. I had not sent that letter to the post when I received one from Lyell and Hooker, urging me to send some MS. to them, and allow them to act as they thought fair and honestly to both of us; and I did so.

To T. H. Huxley.

July 20th [1860].

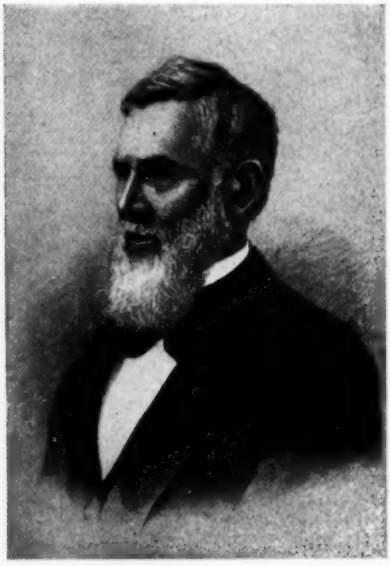
Many thanks for your pleasant letter. I agree to every word you say about *Fraser* and the *Quarterly*. I have had some really admirable letters from Hopkins. I do not suppose he has ever troubled his head about geographical distribution, classification, morphologies, etc., and it is only those who have that will feel any relief in having some sort of rational explanation of such facts. Is it not grand the way in which the Bishop asserts that all such facts are explained by ideas in God's mind? The *Quarterly* is uncommonly clever; and I chuckled much at the way my grandfather and self are quizzed. I could here and there see Owen's hand. By the way, how comes it that you were not attacked? Does Owen begin to find it more prudent to leave you alone? I would give five shillings to know what tremendous blunder the Bishop made; for I see that a page has been cancelled and a new page gummed in.

I am indeed most thoroughly contented with the progress of opinion. From all that I hear from several quarters, it seems that Oxford did the subject great good. It is of enormous importance the showing the world that a few first-rate men are not afraid of expressing their opinion. I see daily more and more plainly that my unaided

book would have done absolutely nothing. Asa Gray is fighting admirably in the United States. He is thorough master of the subject, which cannot be said by any means of such men as even Hopkins.

T. H. HUXLEY.

I have been thinking over what you allude to about a natural history review. I suppose you mean really a *review* and not a journal for original communications in Natural History. Of the latter there is now superabundance. With



ASA GRAY.

J. D. HOOKER.

respect to a good review, there can be no doubt of its value and utility; nevertheless, if not too late, I hope you will consider deliberately before you decide. Remember what a deal of work you have on your shoulders, and though you can do much, yet there is a limit to even the hardest worker's power of working. I should deeply regret to see you sacrificing much time which could be given to original research. I fear, to one who can review as well as

you do, there would be the same temptation to waste time, as there notoriously is for those who can speak well.

A review is only temporary; your work should be perennial. I know well that you may say that unless good men will review there will be no good reviews. And this is true. Would you not do more good by an occasional review in some well-established review, than by giving up much time to the editing, or largely aiding, if not editing, a review which from being confined to one subject would not have a very large circulation? But I must return to the chief idea which strikes me—viz., that it would lessen the amount of original and perennial work which you could do. Reflect how few men there are in England who can do original work in the several lines in which you are excellently fitted. Lyell, I remember, on analogous grounds many years ago resolved he would write no more reviews. I am an old slow-coach, and your scheme makes me tremble. God knows in one sense I am about the last man in England who ought to throw cold water on any review in which you would be concerned, as I have so immensely profited by your labours in this line.

With respect to reviewing myself, I never tried: any work of that kind stops me doing anything else, as I cannot possibly work at odds and ends of time. I have, moreover, an insane hatred of stopping my regular current of work. I have now materials for a little paper or two, but I know I shall never work them up. So I will not promise to help; though not to help, if I could, would make me feel very ungrateful to you. You have no idea during how short a time daily I am able to work. If I had any regular duties, like you and Hooker, I should do absolutely nothing in science.

I am heartily glad to hear that you are better; but how such labour as volunteer-soldiering (all honour to you) does not kill you, I cannot understand.

For God's sake remember that your field of labour is original research in the highest and most difficult branches of Natural History. Not that I wish to underrate the importance of clever and solid reviews.

To J. D. Hooker.

Down, Feb. 14th [1860].

I succeeded in persuading myself for twenty-four hours that Huxley's lecture* was a success. Parts were eloquent and good, and all very bold; and I heard strangers say, 'What a good lecture!' I told Huxley so; but I demurred much to the time wasted in introductory remarks, especially to his making it appear that sterility was a clear and manifest distinction of species, and to his not having even alluded

* At the Royal Institution.

to the more important parts of the subject. He said that he had much more written out, but time failed. After conversation with others and more reflection, I must confess that as an exposition of the doctrine the lecture seems to me an entire failure. I thank God I did not think so when I saw Huxley; for he spoke so kindly and magnificently of me, that I could hardly have endured to say what I now think. He gave no just idea of Natural Selection. I have always looked at the doctrine of Natural Selection as an hypothesis, which, if it explained several large classes of facts, would deserve to be ranked as a theory deserving acceptance; and this, of course, is my own opinion. But, as Huxley has never alluded to my explanation of classification, morphology, embryology, etc., I thought he was thoroughly dissatisfied with all this part of my book. But to my joy I find it is not so, and that he agrees with my manner of looking at the subject; only that he rates higher than I do the necessity of Natural Selection being shown to be a *vera causa* always in action. He tells me he is writing a long review in the *Westminster*. It was really provoking how he wasted time over the idea of a species as exemplified in the horse, and over Sir J. Hall's old experiment on marble. Murchison was very civil to me over my book after the lecture, in which he was disappointed. I have quite made up my mind to a savage onslaught; but with Lyell, you, and Huxley, I feel confident we are right, and in the long run shall prevail. I do not think Asa Gray has quite done you justice in the beginning of the review of me. The review seemed to me very good, but I read it very hastily.

To J. D. Hooker.

Down, Nov. 20th [1862].

Your last letter has interested me to an extraordinary degree, and your truly parsonic advice, 'some other wise and discreet person,' etc., etc., amused us not a little. I will put a concrete case to show what I think A. Gray believes about crossing and what I believe. If 1,000 pigeons were bred together in a cage for 10,000 years their number not being allowed to increase by chance killing, then from mutual intercrossing no varieties would arise; but, if each pigeon were a self-fertilising hermaphrodite, a multitude of varieties would arise. This, I believe, is the common effect of crossing, viz., the obliteration of incipient varieties. I do not deny that when two marked varieties have been produced, their crossing will produce a third or more intermediate varieties. Possibly, or probably, with domestic varieties, with a strong tendency to vary, the act of crossing tends to give rise to new characters; and thus a third or more races, not strictly intermediate, may be produced. But there is heavy evi-

dence against new characters arising from crossing wild forms; only intermediate races are then produced. Now, do you agree thus far? if not, it is no use arguing; we must come to swearing, and I am convinced I can swear harder than you, ∴ I am right. Q.E.D.

If the number of 1,000 pigeons were prevented increasing not by chance killing, but by, say, all the shorter-beaked birds being killed, then the *whole* body would come to have longer beaks. Do you agree?

Thirdly, if 1,000 pigeons were kept in a hot country, and another 1,000 in a cold country, and fed on different food, and confined in different-size aviary, and kept constant in number by chance killing, then I should expect as rather probable that after 10,000 years the two bodies would differ slightly in size, colour, and perhaps other trifling characters; this I should call the direct action of physical conditions. By this action I wish to imply that the innate vital forces are somehow led to act rather differently in the two cases, just as heat will allow or cause two elements to combine, which otherwise would not have combined. I should be especially obliged if you would tell me what you think on this head.

But the part of your letter which fairly pitched me head over heels with astonishment, is that where you state that every single difference which we see might have occurred without any selection. I do and have always fully agreed; but you have got right round the subject, and viewed it from an entirely opposite and new side, and when you took me there I was astounded. When I say I agree, I must make the proviso, that under your view, as now, each form long remains adapted to certain fixed conditions, and that the conditions of life are in the long run changeable; and second, which is more important, that each individual form is a self-fertilising hermaphrodite, so that each hair-breadth variation is not lost by intercrossing. Your manner of putting the case would be even more striking than it is if the mind could grapple with such numbers—it is grappling with eternity—think of each of a thousand seeds bringing forth its plant, and then each a thousand. A globe stretching to the furthest fixed star would very soon be covered. I cannot even grapple with the idea, even with races of dogs, cattle, pigeons, or fowls; and here all admit and see the accurate strictness of your illustration.

Such men as you and Lyell thinking that I make too much of a Deus of Natural Selection is a conclusive argument against me. Yet I hardly know how I could have put in, in all parts of my book, stronger sentences. The title, as you once pointed out, might have been better. No one ever objects to agriculturists using the strongest language about their selection, yet every breeder knows that he does not produce the modification which he selects. My enormous diffi-

culty for years was to understand adaptation, and this made me, I cannot but think, rightly, insist so much on Natural Selection. God forgive me for writing at such length; but you cannot tell how much your letter has interested me, and how important it is for me with my present book in hand to try and get clear ideas. Do think a bit about what is meant by direct action of physical conditions. I do not mean whether they act; my facts will throw some light on this. I am collecting all cases of bud-variations, in contradistinction to seed-variations (do you like this term, for what some gardeners call 'sports'?); these eliminate all effects of crossing. Pray remember how much I value your opinion as the clearest and most original I ever get.

I see plainly that *Welwitschia* will be a case of Barnacles.

I have another plant to beg, but I write on separate paper as more convenient for you to keep. I meant to have said before, as an excuse for asking for so much from Kew, that I have now lost *two* seasons, by accursed nurserymen not having right plants, and sending me the wrong instead of saying that they did not possess.

To J. D. Hooker.

Freshwater, Isle of Wight, July 28th [1868].

I am glad to hear that you are going to touch on the statement that the belief in Natural Selection is passing away. I do not suppose that even the *Athenæum* would pretend that the belief in the common descent of species is passing away, and this is the more important point. This now almost universal belief in the evolution (somehow) of species, I think may be fairly attributed in large part to the *Origin*. It would be well for you to look at the short Introduction of Owen's *Anat. of Invertebrates,* and see how fully he admits the descent of species.

Of the *Origin,* four English editions, one or two American, two French, two German, one Dutch, one Italian, and several (as I was told) Russian editions. The translations of my book on *Variation under Domestication* are the results of the *Origin;* and of these two English, one American, one German, one French, one Italian, and one Russian have appeared, or will soon appear. Ernst Häckel wrote to me a week or two ago, that new discussions and reviews of the *Origin* are continually still coming out in Germany, where the interest on the subject certainly does not diminish. I have seen some of these discussions, and they are good ones. I apprehend that the interest on the subject has not died out in North America, from observing in Professor and Mrs. Agassiz's Book on Brazil how excessively anxious he is to destroy me. In regard to this country, every one can judge

for himself, but you would not say interest was dying out if you were to look at the last number of the *Anthropological Review,* in which I am incessantly sneered at. I think Lyell's *Principles* will produce a considerable effect. I hope I have given you the sort of information which you want. My head is rather unsteady, which makes my handwriting worse than usual.

If you argue about the non-acceptance of Natural Selection, it seems to me a very striking fact that the Newtonian theory of gravitation, which seems to every one now so certain and plain, was rejected by a man so extraordinarily able as Leibnitz. The truth will not penetrate a preoccupied mind.

Wallace, in the *Westminster Review,* in an article on Protection has a good passage, contrasting the success of Natural Selection and its growth with the comprehension of new classes of facts, with false theories, such as the Quinarian Theory, and that of Polarity, by poor Forbes, both of which were promulgated with high advantages and the first temporarily accepted.

To C. Lyell.

15, Marine Parade, Eastbourne, Oct. 3rd [1860].

Your last letter has interested me much in many ways.

I enclose a letter of Wyman's which touches on brains. Wyman is mistaken in supposing that I did not know that the Cave-rat was an American form; I made special enquiries. He does not know that the eye of the Tucutuco was carefully dissected.

With respect to reviews by A. Gray. I thought of sending the Dialogue to the *Saturday Review* in a week's time or so, as they have lately discussed Design. I have sent the second, or August, *Atlantic* article to the *Annals and Mag. of Nat. History.* The copy which you have I want to send to Pictet, as I told A. Gray I would, thinking from what he said he would like this to be done. I doubt whether it would be possible to get the October number reprinted in this country; so that I am in no hurry at all for this.

I had a letter a few weeks ago from Symonds on the imperfection of the Geological Record, less clear and forcible than I expected. I answered him at length and very civilly, though I could hardly make out what he was driving at. He spoke about you in a way which it did me good to read.

I am extremely glad that you like A. Gray's reviews. How generous and unselfish he has been in all his labour! Are you not struck by his metaphors and similes? I have told him he is a poet and not a lawyer.

I should altogether doubt on turtles being converted into land tortoises on any one island. Remember how closely similar tortoises are

on all continents, as well as islands; they must have all descended from one ancient progenitor, including the gigantic tortoise of the Himalaya.

I think you must be cautious in not running the convenient doctrine that only one species out of very many ever varies. Reflect on such cases as the fauna and flora of Europe, North America, and Japan, which are so similar, and yet which have a great majority of their species either specifically distinct, or forming well-marked races. We must in such cases incline to the belief that a multitude of species were once identically the same in all the three countries when under a warmer climate and more in connection; and have varied in all the three countries. I am inclined to believe that almost every species (as we see with nearly all our domestic productions) varies sufficiently for Natural Selection to pick out and accumulate new specific differences, under new organic and inorganic conditions of life, whenever a place is open in the polity of nature. But looking to a long lapse of time and to the whole world, or to large parts of the world, I believe only one or a few species of each large genus ultimately becomes victorious, and leaves modified descendants. To give an imaginary instance: the jay has become modified in the three countries into (I believe) three or four species; but the jay genus is not, apparently, so dominant a group as the crows; and in the long run probably all the jays will be exterminated and be replaced perhaps by some modified crows.

I merely give this illustration to show what seems to me probable.

But oh! what work there is before we shall understand the genealogy of organic beings!

With respect to the *Apteryx*, I know not enough of anatomy; but ask Dr. F. whether the clavicle, etc., do not give attachment to some of the muscles of respiration. If my views are at all correct, the wing of the *Apteryx* cannot be (p. 452 of the *Origin*) a nascent organ, as these wings are useless. I dare not trust to memory, but I know I found the whole sternum always reduced in size in all the fancy and confined pigeons relatively to the same bones in the wild Rock-pigeon: the keel was generally still further reduced relatively to the reduced length of the sternum; but in some breeds it was in a most anomalous manner more prominent. I have got a lot of facts on the reduction of the organs of flight in the pigeon, which took me weeks to work out, and which Huxley thought curious.

I am utterly ashamed, and groan over my handwriting. It was 'Natural Preservation.' Natural persecution is what the author ought to suffer. It rejoices me that you do not object to the term. Hooker made the same remark that it ought to have been 'Variation and Natural Selection.' Yet with domestic productions, when selec-

tion is spoken of, variation is always implied. But I entirely agree with your and Hooker's remark.

Have you begun regularly to write your book on the antiquity of man?

I do *not* agree with your remark that I make Natural Selection do too much work. You will perhaps reply that every man rides his hobby-horse to death; and that I am in the galloping state.

To C. LYELL.

TORQUAY, Aug. 21st [1861].

I am pleased that you approve of Hutton's review. It seemed to me to take a more philosophical view of the manner of judging the question than any other review. The sentence you quote from it seems very true, but I do not agree with the theological conclusion. I think he quotes from Asa Gray, certainly not from me; but I have neither A. Gray nor *Origin* with me. Indeed, I have over and over again said in the *Origin* that Natural Selection does nothing without variability; I have given a whole chapter on laws, and used the strongest language how ignorant we are on these laws. But I agree that I have somehow (Hooker says it is owing to my title) not made the great and manifest importance of previous variability plain enough. Breeders constantly speak of Selection as the one great means of improvement; but of course they imply individual differences, and this I should have thought would have been obvious to all in Natural Selection; but it has not been so.

I have just said that I cannot agree with 'which variations are the effects of an unknown law, ordained and guided without doubt by an intelligent cause on a preconceived and definite plan.' Will you honestly tell me (and I should be really much obliged) whether you believe that the shape of my nose (eheu!) was ordained and 'guided by an intelligent cause?' By the selection of analogous and less differences fanciers make almost generic differences in their pigeons; and can you see any good reason why the Natural Selection of analogous individual differences should not make new species? If you say that God ordained that at some time and place a dozen slight variations should arise, and that one of them alone should be preserved in the struggle for life and the other eleven should perish in the first or few first generations, then the saying seems to me mere verbiage. It comes to merely saying that everything that is, is ordained.

Let me add another sentence. Why should you or I speak of variation as having been ordained and guided, more than does an astronomer, in discussing the fall of a meteoric stone? He would simply say that it was drawn to our earth by the attraction of gravity,

having been displaced in its course by the action of some quite unknown laws. Would you have him say that its fall at some particular place and time was 'ordained and guided without doubt by an intelligent cause on a preconceived and definite plan?' Would you not call this theological pedantry or display? I believe it is not pedantry in the case of species, simply because their formation has hitherto been viewed as beyond law; in fact, this branch of science is still with most people under its theological phase of development. The conclusion which I always come to after thinking of such questions is that they are beyond the human intellect; and the less one thinks on them the better. You may say, Then why trouble me? But I should very much like to know clearly what you think.

To Asa Gray.

Down, Nov. 29th [1859].

This shall be such an extraordinary note as you have never received from me, for it shall not contain one single question or request. I thank you for your impression on my views. Every criticism from a good man is of value to me. What you hint at generally is very, very true: that my work will be grievously hypothetical, and large parts by no means worthy of being called induction, my commonest error being probably induction from too few facts. I had not thought of your objection of my using the term 'natural selection' as an agent. I use it much as a geologist does the word denudation—for an agent, expressing the result of several combined actions. I will take care to explain, not merely by inference, what I mean by the term; for I must use it, otherwise I should incessantly have to expand it into some such (here miserably expressed) formula as the following: "The tendency to the preservation (owing to the severe struggle for life to which all organic beings at some time or generation are exposed) of any, the slightest, variation in any part, which is of the slightest use or favourable to the life of the individual which has thus varied; together with the tendency to its inheritance." Any variation, which was of no use whatever to the individual, would not be preserved by this process of 'natural selection.' But I will not weary you by going on, as I do not suppose I could make my meaning clearer without large expansion. I will only add one other sentence: several varieties of sheep have been turned out together on the Cumberland mountains, and one particular breed is found to succeed so much better than all the others that it fairly starves the others to death. I should here say that natural selection picks out this breed, and would tend to improve it, or aboriginally to have formed it. . . .

You speak of species not having any material base to rest on, but is this any greater hardship than deciding what deserves to be called a variety, and be designated by a Greek letter? When I was at systematic work I know I longed to have no other difficulty (great enough) than deciding whether the form was distinct enough to deserve a name, and not to be haunted with undefined and unanswerable questions whether it was a true species. What a jump it is from a well-marked variety, produced by natural cause, to a species produced by the separate act of the hand of God! But I am running on foolishly. By the way, I met the other day Phillips, the palæontologist, and he asked me, 'How do you define a species?' I answered, 'I can not.' Whereupon he said, 'At last I have found out the only true definition—any form which has ever had a specific name! . . .'

To Asa Gray.

Down, June 8th [1860].

I have to thank you for two notes, one through Hooker, and one with some letters to be posted, which was done. I anticipated your request by making a few remarks on Owen's review. Hooker is so weary of reviews that I do not think you will get any hints from him. I have lately had many more 'kicks than halfpence.' A review in the last Dublin *Nat. Hist. Review* is the most unfair thing which has appeared,—one mass of misrepresentation. It is evidently by Haughton, the geologist, chemist and mathematician. It shows immeasurable conceit and contempt of all who are not mathematicians. He discusses bees' cells, and puts a series which I have never alluded to, and wholly ignores the intermediate comb of *Melipona,* which alone led me to my notions. The article is a curiosity of unfairness and arrogance; but, as he sneers at Malthus, I am content, for it is clear he can not reason. He is a friend of Harvey, with whom I have had some correspondence. Your article has clearly, as he admits, influenced him. He admits to a certain extent Natural Selection, yet I am sure does not understand me. It is strange that very few do, and I am become quite convinced that I must be an extremely bad explainer. To recur for a moment to Owen: he grossly misrepresents and is very unfair to Huxley. You say that you think the article must be by a pupil of Owen; but no one fact tells so strongly against Owen, considering his former position at the College of Surgeons, as that he has never reared one pupil or follower. In the number just out of *Fraser's Magazine* there is an article or review on Lamarck and me by W. Hopkins, the mathematician, who, like Haughton, despises the reasoning power of all naturalists. Personally he is extremely kind towards me; but he evidently in the following number means to blow

me into atoms. He does not in the least appreciate the difference in my views and Lamarck's, as explaining adaptation, the principle of divergence, the increase of dominant groups, and the almost necessary extinction of the less dominant and smaller groups, etc.

To Asa Gray.

Down, July 23rd [1862].

I received several days ago two large packets, but have as yet read only your letter; for we have been in fearful distress, and I could attend to nothing. Our poor boy had the rare case of second rash and sore throat . . .; and, as if this was not enough, a most serious attack of erysipelas, with typhoid symptoms. I despaired of his life; but this evening he has eaten one mouthful, and I think has passed the crisis. He has lived on port wine every three-quarters of an hour, day and night. This evening, to our astonishment, he asked whether his stamps were safe, and I told him of one sent by you, and that he should see it to-morrow. He answered, 'I should awfully like to see it now'; so with difficulty he opened his eyelids and glanced at it, and, with a sigh of satisfaction, said, 'All right.' Children are one's greatest happiness, but often and often a still greater misery. A man of science ought to have none—perhaps not a wife; for then there would be nothing in this wide world worth caring for, and a man might (whether he could is another question) work away like a Trojan. I hope in a few days to get my brains in order, and then I will pick out all your orchid letters, and return them in hopes of your making use of them. . . .

Of all the carpenters for knocking the right nail on the head, you are the very best; no one else has perceived that my chief interest in my orchid book has been that it was a 'flank movement' on the enemy. I live in such solitude that I hear nothing, and have no idea to what you allude about Bentham and the orchids and species. But I must enquire.

By the way, one of my chief enemies (the sole one who has annoyed me), namely Owen, I hear has been lecturing on birds; and admits that all have descended from one, and advances as his own idea that the oceanic wingless birds have lost their wings by gradual disuse. He never alludes to me, or only with bitter sneers, and coupled with Buffon and the *Vestiges*.

Well, it has been an amusement to me this first evening, scribbling as egotistically as usual about myself and my doings; so you must forgive me, as I know well your kind heart will do. I have managed to skim the newspaper, but had not heart to read all the bloody details. Good God! what will the end be? Perhaps we are too de-

spondent here; but I must think you are too hopeful on your side of the water. I never believed the 'canards' of the army of the Potomac having capitulated. My good dear wife and self are come to wish for peace at any price. Good night, my good friend. I will scribble on no more.

One more word. I should like to hear what you think about what I say in the last chapter of the orchid book on the meaning and cause of the endless diversity of means for the same general purpose. It bears on design, that endless question. Good night, good night!

To J. D. DANA.

DOWN, Dec. 5th, 1849.

I have not for some years been so much pleased as I have just been by reading your most able discussion on coral reefs. I thank you most sincerely for the very honourable mention you make of me. This day I heard that the atlas has arrived, and this completes your munificent present to me. I have not yet come to the chapter on subsidence, and in that I fancy we shall disagree, but in the descriptive part our agreement has been eminently satisfactory to me, and far more than I ever ventured to anticipate. I consider that now the subsidence theory is established. I have read about half through the descriptive part of the *Volcanic Geology* (last night I ascended the peaks of Tahiti with you, and what I saw in my short excursion was most vividly brought before me by your descriptions), and have been most deeply interested by it. Your observations on the Sandwich craters strike me as the most important and original of any that I have read for a long time. Now that I have read yours, I believe I saw at the Galapagos, at a distance, instances of those most curious fissures of eruption. There are many points of resemblance between the Galapagos and Sandwich Islands (even to the shape of the mound-like hills)—viz., in the liquidity of the lavas, absence of scoriæ, and tuff-craters, Many of your scattered remarks on denudation have particularly interested me; but I see that you attribute less to sea and more to running water than I have been accustomed to do. After your remarks in your last very kind letter I could not help skipping on to the Australian valleys, on which your remarks strike me as exceedingly ingenious and novel, but they have not converted me. I can not conceive how the great lateral bays could have been scooped out, and their sides rendered precipitous by running water. I shall go on and read every word of your excellent volume.

If you look over my *Geological Instructions* you will be amused to see that I urge attention to several points which you have elaborately discussed. I lately read a paper of yours on Chambers' book,

and was interested by it. I really believe the facts of the order described by Chambers, in S. America, which I have described in my Geolog. volume. This leads me to ask you (as I can not doubt that you will have much geological weight in N. America) to look to a discussion at p. 135 in that volume on the importance of subsidence to the formation of deposits, which are to last to a distant age. This view strikes me as of some importance.

When I meet a very good-natured man I have that degree of badness of disposition in me that I always endeavour to take advantage of him; therefore I am going to mention some desiderata, which if you can supply I shall be very grateful, but if not no answer will be required.

Thank you for your *Conspectus Crust.*, but I am sorry to say I am not worthy of it, though I have always thought the Crustacea a beautiful subject.

To J. D. DANA.

DOWN, July 30th (1860).

I received several weeks ago your note telling me that you could not visit England, which I sincerely regretted, as I should most heartily have liked to have made your personal acquaintance. You gave me an improved, but not very good, account of your health. I should at some time be grateful for a line to tell me how you are. We have had a miserable summer, owing to a terribly long and severe illness of my eldest girl, who improves slightly but is still in a precarious condition. I have been able to do nothing in science of late. My kind friend Asa Gray often writes to me and tells me of the warm discussions on the *Origin of Species* in the United States. Whenever you are strong enough to read it, I know you will be dead against me, but I know equally well that your opposition will be liberal and philosophical. And this is a good deal more than I can say of all my opponents in this country. I have not yet seen Agassiz's attack, but I hope to find it at home when I return in a few days, for I have been for several weeks away from home on my daughter's account. Prof. Silliman sent me an extremely kind message by Asa Gray that your Journal would be open to a reply by me. I cannot decide till I see it, but on principle I have resolved to avoid answering anything, as it consumes much time, often temper, and I have said my say in the *Origin*. No one person understands my views and has defended them so well as A. Gray, though he does not by any means go all the way with me. There was much discussion on the subject at the British Association at Oxford, and I had many defenders, and my side seems (for I was not there) almost to have got the best of the battle. Your correspondent and my neighbour, J. Lubbock, goes on working at such spare time as he has.

This is an egotistical note, but I have not seen a naturalist for months. Most sincerely and deeply do I hope that this note may find you almost recovered.

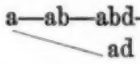
To A. HYATT.

DOWN, Dec. 4th, 1872.

I thank you sincerely for your most interesting letter. You refer much too modestly to your own knowledge and judgment, as you are much better fitted to throw light on your own difficult problems than I am.

It has quite annoyed me that I do not clearly understand yours and Prof. Cope's views; and the fault lies in some slight degree, I think, with Prof. Cope, who does not write very clearly. I think I now understand the terms 'acceleration' and 'retardation'; but will you grudge the trouble of telling me, by the aid of the following illustration, whether I do understand rightly? When a fresh-water decapod crustacean is born with an almost mature structure, and therefore does not pass, like other decapods, through the Zoea stage, is this not a case of acceleration? Again, if an imaginary decapod retained, when adult, many Zoea characters, would this not be case of retardation? If these illustrations are correct, I can perceive why I have been so dull in understanding your views. I looked for something else, being familiar with such cases, and classing them in my own mind as simply due to the obliteration of certain larval or embryonic stages. This obliteration I imagined resulted sometimes entirely from that law of inheritance to which you allude; but that it in many cases was aided by Natural Selection, as I inferred from such cases occurring so frequently in terrestrial and fresh-water members of groups, which retain their several embryonic stages in the sea, as long as fitting conditions are present.

Another cause of my misunderstanding was the assumption that in your series



the differences between the successive species, expressed by the terminal letter, was due to acceleration: now, if I understand rightly, this is not the case; and such characters must have been independently acquired by some means.

The two newest and most interesting points in your letter (and in, as far as I think, your former paper) seem to me to be about senile characteristics in one species appearing in succeeding species during maturity; and secondly about certain degraded characters appearing in the last species of a series. You ask for my opinion: I can only send the conjectured impressions which have occurred to me and which are not worth writing. (It ought to be known whether the senile

character appears before or after the period of active reproduction.) I should be inclined to attribute the character in both your cases to the laws of growth and descent, secondarily to Natural Selection. It has been an error on my part, and a misfortune to me, that I did not largely discuss what I mean by laws of growth at an early period in some of my books. I have said something on this head in two new chapters in the last edition of the *Origin*. I should be happy to send you a copy of this edition, if you do not possess it and care to have it. A man in extreme old age differs much from a young man, and I presume every one would account for this by failing powers of growth. On the other hand the skulls of some mammals go on altering during maturity into advancing years; as do the horns of the stag, the tail-feathers of some birds, the size of fishes, etc.; and all such differences I should attribute simply to the laws of growth, as long as full vigour was retained. Endless other changes of structure in successive species may, I believe, be accounted for by various complex laws of growth. Now, any change of character thus induced with advancing years in the individual might easily be inherited at an earlier age than that at which it first supervened, and thus become characteristic of the mature species; or again, such changes would be apt to follow from variation, independently of inheritance, under proper conditions. Therefore I should expect that characters of this kind would often appear in later-formed species without the aid of Natural Selection, or with its aid if the characters were of any advantage. The longer I live, the more I become convinced how ignorant we are of the extent to which all sorts of structures are serviceable to each species. But that characters supervening during maturity in one species should appear so regularly, as you state to be the case, in succeeding species, seems to me very surprising and inexplicable.

With respect to degradation in species towards the close of a series, I have nothing to say, except that before I arrived at the end of your letter, it occurred to me that the earlier and simpler ammonites must have been well adapted to their conditions, and that when the species were verging towards extinction (owing probably to the presence of some more successful competitors) they would naturally become re-adapted to simpler conditions. Before I had read your final remarks I thought also that unfavourable conditions might cause, through the law of growth, aided perhaps by reversion, degradation of character. No doubt many new laws remain to be discovered. Permit me to add that I have never been so foolish as to imagine that I have succeeded in doing more than to lay down some of the broad outlines of the origin of species.

After long reflection I cannot avoid the conviction that no innate tendency to progressive development exists, as is now held by so many

able naturalists, and perhaps by yourself. It is curious how seldom writers define what they mean by progressive development; but this is a point which I have briefly discussed in the *Origin*. I earnestly hope that you may visit Hilgendorf's famous deposit. Have you seen Weismann's pamphlet *Einfluss der Isolirung*, Leipzig, 1872? He makes splendid use of Hilgendorf's admirable observations. I have no strength to spare, being much out of health; otherwise I would have endeavoured to have made this letter better worth sending. I most sincerely wish you success in your valuable and difficult researches.

I have received, and thank you, for your three pamphlets. As far as I can judge, your views seem very probable; but what a fearfully intricate subject is this of the succession of ammonites.

To B. D. WALSH.

DOWN, Dec. 4th [1864].

I have been greatly interested by your account of your American life. What an extraordinary and self-contained life you have led! and what vigour of mind you must possess to follow science with so much ardour after all that you have undergone! I am very much obliged to you for your pamphlet on Geographical Distribution, on Agassiz, etc. I am delighted at the manner in which you have bearded this lion in his den. I agree most entirely with all that you have written. What I meant when I wrote to Agassiz to thank him for a bundle of his publications, was exactly what you suppose. I confess, however, I did not fully perceive how he had misstated my views; but I only skimmed through his *Methods of Study*, and thought it a very poor book. I am so much accustomed to be utterly misrepresented that it hardly excites my attention. But you really have hit the nail on the head capitally. All the younger good naturalists whom I know think of Agassiz as you do; but he did grand service about glaciers and fish. About the succession of forms, Pictet has given up his whole views, and no geologist now agrees with Agassiz. I am glad that you have attacked Dana's wild notions; [though] I have a great respect for Dana. . . . If you have an opportunity, read in *Trans. Linn. Soc.* Bates on 'Mimetic Lepidoptera of Amazons.' I was delighted with his paper.

I have got a notice of your views about the female *Cynips* inserted in the *Natural History Review:* whether the notice will be favourable, I do not know; but anyhow it will call attention to your views. . . .

As you allude in your paper to the believers in change of species, you will be glad to hear that very many of the very best men are coming round in Germany. I have lately heard of Häckel, Gegenbauer, F.

Müller, Leuckart, Claparède, Alex. Braun, Schleiden, etc. So it is, I hear, with the younger Frenchmen.

To C. V. Riley.

Down, June 1st [1871].

I received some little time ago your report on noxious insects, and have now read the whole with the greatest interest. There are a vast number of facts and generalisations of value to me, and I am struck with admiration at your powers of observation.

The discussion on mimetic insects seems to me particularly good and original. Pray accept my cordial thanks for the instruction and interest which I have received.

What a loss to Natural Science our poor mutual friend Walsh has been; it is a loss ever to be deplored. . . .

Your country is far ahead of ours in some respects; our Parliament would think any man mad who should propose to appoint a State Entomologist.

To E. S. Morse.

Down, Oct. 21st, 1879.

Although you are so kind as to tell me not to write, I must just thank you for the proofs of your paper,* which has interested me greatly. The increase in the number of ridges in the three species of *Arca* seems to be a very noteworthy fact, as does the increase of size in so many, yet not all, the species. What a constant state of fluctuation the whole organic world seems to be in! It is interesting to hear that everywhere the first change apparently is in the proportional numbers of the species. I was much struck with the fact in the upraised shells of Coquimbo, in Chili, as mentioned in my *Geological Observations on South America.*

Of all the wonders in the world, the progress of Japan, in which you have been aiding, seems to me about the most wonderful.

To A. Agassiz.

Down, May 5th, 1881.

It was very good of you to write to me from Tortugas, as I always feel much interested in hearing what you are about, and in reading your many discoveries. It is a surprising fact that the peninsula of Florida should have remained at the same level for the immense period requisite for the accumulation of so vast a pile of débris.

You will have seen Mr. Murray's views on the formation of atolls and barrier reefs. Before publishing my book, I thought long over the same view, but only as far as ordinary marine organisms are concerned, for at that time little was known of the multitude of minute

* 'The Shell Mounds of Omori.'

oceanic organisms. I rejected this view, as from the few dredgings made in the *Beagle* in the S. Temperate regions, I concluded that shells, the smaller corals, etc., etc., decayed and were dissolved when not protected by the deposition of sediment; and sediment could not accumulate in the open ocean. Certainly shells, etc., were in several cases completely rotten, and crumbled into mud between my fingers; but you will know well whether this is in any degree common. I have expressly said that a bank at the proper depth would give rise to an atoll, which could not be distinguished from one formed during subsidence. I can, however, hardly believe, in the former presence of as many banks (there having been no subsidence) as there are atolls in the great oceans, within a reasonable depth, on which minute oceanic organisms could have accumulated to the thickness of many hundred feet. I think that it has been shown that the oscillations from great waves extend down to a considerable depth, and if so the oscillating water would tend to lift up (according to an old doctrine propounded by Playfair) minute particles lying at the bottom, and allow them to be slowly drifted away from the submarine bank by the slightest current. Lastly, I can not understand Mr. Murray, who admits that small calcareous organisms are dissolved by the carbonic acid in the water at great depths, and that coral reefs, etc., etc., are likewise dissolved near the surface, but that this does not occur at intermediate depths, where he believes that the minute oceanic calcareous organisms accumulate until the bank reaches within the reef-building depth. But I suppose that I must have misunderstood him.

Pray forgive me for troubling you at such length, but it has occurred to me that you might be disposed to give, after your wide experience, your judgment. If I am wrong, the sooner I am knocked on the head and annihilated so much the better. It still seems to me a marvelous thing that there should not have been much and long-continued subsidence in the beds of the great oceans. I wish that some doubly rich millionaire would take it into his head to have borings made in some of the Pacific and Indian atolls, and bring home cores for slicing from a depth of 500 or 600 feet.

To Mrs. Emily Talbot, Boston.

Down, July 19th, [1881?].

In response to your wish, I have much pleasure in expressing the interest which I feel in your proposed investigation on the mental and bodily development of infants. Very little is at present accurately known on this subject, and I believe that isolated observations will add but little to our knowledge, whereas tabulated results from a very large number of observations, systematically made, would probably

throw much light on the sequence and period of development of the several faculties. This knowledge would probably give a foundation for some improvement in our education of young children, and would show us whether the system ought to be followed in all cases.

I will venture to specify a few points of inquiry which, as it seems to me, possess some scientific interest. For instance, does the education of the parents influence the mental powers of their children at any age, either at a very early or somewhat more advanced stage? This could perhaps be learned by schoolmasters and mistresses if a large number of children were first classed according to age and their mental attainments, and afterwards in accordance with the education of their parents, as far as this could be discovered. As observation is one of the earliest faculties developed in young children, and as this power would probably be exercised in an equal degree by the children of educated and uneducated persons, it seems not impossible that any transmitted effect from education could be displayed only at a somewhat advanced age. It would be desirable to test statistically, in a similar manner, the truth of the oft-repeated statement that coloured children at first learn as quickly as white children, but that they afterwards fall off in progress. If it could be proved that education acts not only on the individual, but, by transmission, on the race, this would be a great encouragement to all working on this all-important subject. It is well known that children sometimes exhibit, at a very early age, strong special tastes, for which no cause can be assigned, although occasionally they may be accounted for by reversion to the taste or occupation of some progenitor; and it would be interesting to learn how far such early tastes are persistent and influence the future career of the individual. In some instances such tastes die away without apparently leaving any after effect, but it would be desirable to know how far this is commonly the case, as we should then know whether it were important to direct as far as this is possible the early tastes of our children. It may be more beneficial that a child should follow energetically some pursuit, of however trifling a nature, and thus acquire perseverance, than that he should be turned from it because of no future advantage to him. I will mention one other small point of inquiry in relation to very young children, which may possibly prove important with respect to the origin of language; but it could be investigated only by persons possessing an accurate musical ear. Children, even before they can articulate, express some of their feelings and desires by noises uttered in different notes. For instance, they make an interrogative noise, and others of assent and dissent, in different tones; and it would, I think, be worth while to ascertain whether there is any uniformity in different children in the pitch of their voices under various frames of mind.

I fear that this letter can be of no use to you, but it will serve to show my sympathy and good wishes in your researches.

To A. R. Wallace.

Down, April 29th [1867].

I have been greatly interested by your letter, but your view is not new to me. If you will look at p. 240 of the fourth edition of the *Origin* you will find it very briefly given with two extreme examples of the peacock and black grouse. A more general statement is given at p. 101, or at p. 89 of the first edition, for I have long entertained this view, though I have never had space to develop it. But I had not sufficient knowledge to generalise as far as you do about colouring and nesting. In your paper perhaps you will just allude to my scanty remark in the fourth edition, because in my Essay on Man I intend to discuss the whole subject of sexual selection, explaining as I believe it does much with respect to man. I have collected all my old notes, and partly written my discussion, and it would be flat work for me to give the leading idea as exclusively from you. But, as I am sure from your greater knowledge of Ornithology and Entomology that you will write a much better discussion than I could, your paper will be of great use to me. Nevertheless I must discuss the subject fully in my Essay on Man. When we met at the Zoological Society, and I asked you about the sexual differences in kingfishers, I had this subject in view; as I had when I suggested to Bates the difficulty about gaudy caterpillars, which you have so admirably (as I believe it will prove) explained. I have got one capital case (genus forgotten) of a [Australian] bird in which the female has long tail-plumes, and which consequently builds a different nest from all her allies. With respect to certain female birds being more brightly coloured than the males, and the latter incubating, I have gone a little into the subject, and can not say that I am fully satisfied. I remember mentioning to you the case of *Rhynchæa,* but its nesting seems unknown. In some other cases the difference in brightness seemed to me hardly sufficiently accounted for by the principle of protection. At the Falkland Islands there is a carrion hawk in which the female (as I ascertained by dissection) is the brightest coloured, and I doubt whether protection will here apply; but I wrote several months ago to the Falklands to make enquiries. The conclusion to which I have been leaning is that in some of these abnormal cases the colour happened to vary in the female alone, and was transmitted to females alone, and that her variations have been selected through the admiration of the male.

It is a very interesting subject, but I shall not be able to go on with it for the next five or six months, as I am fully employed in cor-

recting dull proof-sheets. When I return to the work I shall find it much better done by you than I could have succeeded in doing.

It is curious how we hit on the same ideas. I have endeavoured to show in my MS. discussion that nearly the same principles account for young birds not being gaily coloured in many cases, but this is too complex a point for a note.

On reading over your letter again, and on further reflection, I do not think (as far as I remember my words) that I expressed myself nearly strongly enough on the value and beauty of your generalisation, viz., that all birds in which the female is conspicuously or brightly coloured build in holes or under domes. I thought that this was the explanation in many, perhaps most cases, but do not think I should ever have extended my view to your generalisation. Forgive me troubling you with this P.S.

To A. R. WALLACE.

DOWN, May 5th [1867].

The offer of your valuable notes is most generous, but it would vex me to take so much from you, as it is certain that you could work up the subject very much better than I could. Therefore I earnestly, and without any reservation, hope that you will proceed with your paper, so that I return your notes. You seem already to have well investigated the subject. I confess on receiving your note that I felt rather flat at my recent work being almost thrown away, but I did not intend to show this feeling. As a proof how little advance I had made on the subject, I may mention that though I had been collecting facts on the colouring, and other sexual differences in mammals, your explanation with respect to the females had not occurred to me. I am surprised at my own stupidity, but I have long recognised how much clearer and deeper your insight into matters is than mine. I do not know how far you have attended to the laws of inheritance, so what follows may be obvious to you. I have begun my discussion on sexual selection by showing that new characters often appear in one sex and are transmitted to that sex alone, and that from some unknown cause such characters apparently appear oftener in the male than in the female. Secondly, characters may be developed and be confined to the male, and long afterwards be transferred to the female. Thirdly, characters may arise in either sex and be transmitted to both sexes, either in an equal or unequal degree. In this latter case I have supposed that the survival of the fittest has come into play with female birds and kept the female dull-coloured. With respect to the absence of spurs in the female gallinaceous birds, I presume that they would be in the way during incubation; at least I have got the case of a German breed of fowls in which the hens were spurred, and were found

to disturb and break their eggs much. With respect to the females of deer not having horns, I presume it is to save the loss of organised matter. In your note you speak of sexual selection and protection as sufficient to account for the colouring of all animals, but it seems to me doubtful how far this will come into play with some of the lower animals, such as sea anemones, some corals, etc., etc. On the other hand Häckel has recently well shown that the transparency and absence of colour in the lower oceanic animals, belonging to the most different classes, may be well accounted for on the principle of protection.

Some time or other I should like much to know where your paper on the nests of birds has appeared, and I shall be extremely anxious to read your paper in the *Westminster Review*. Your paper on the sexual colouring of birds will, I have no doubt, be very striking. Forgive me, if you can, for a touch of illiberality about your paper.

To Aug. Weismann.

Down, Feb. 29th, 1872.

I am rejoiced to hear that your eyesight is somewhat better; but I fear that work with the microscope is still out of your power. I have often thought with sincere sympathy how much you must have suffered from your grand line of embryological research having been stopped. It was very good of you to use your eyes in writing to me. I have just received your essay; but as I am now staying in London for the sake of rest, and as German is at all times very difficult to me, I shall not be able to read your essay for some little time. I am, however, very curious to learn what you have to say on isolation and on periods of variation. I thought much about isolation when I wrote in Chapter IV. on the circumstances favourable to Natural Selection. No doubt there remains an immense deal of work to do on 'Artbildung.' I have only opened a path for others to enter, and in the course of time to make a broad and clear high-road. I am especially glad that you are turning your attention to sexual selection. I have in this country hardly found any naturalists who agree with me on this subject, even to a moderate extent. They think it absurd that a female bird should be able to appreciate the splendid plumage of the male; but it would take much to persuade me that the peacock does not spread his gorgeous tail in the presence of the female in order to fascinate or excite her. The case, no doubt, is much more difficult with insects. I fear that you will find it difficult to experiment on diurnal lepidoptera in confinement, for I have never heard of any of these breeding in this state. I was extremely pleased at hearing from Fritz Müller that he liked my chapter on lepidoptera in the *Descent of Man* more than any other part, excepting the chapter on morals.

To T. H. Huxley.

Worthing, Sept. 9th, 1881.

We have been paying Mr. Rich* a little visit, and he has often spoken of you, and I think he enjoyed much your and Mrs. Huxley's visit here. But my object in writing now is to tell you something, which I am very doubtful whether it is worth while for you to hear, because it is uncertain. My brother Erasmus has left me half his fortune, which is very considerable. Therefore, I thought myself bound to tell Mr. Rich of this, stating the large amount, as far as the executors as yet know it roughly. I then added that my wife and self thought that, under these new circumstances, he was most fully justified in altering his will and leaving his property in some other way. I begged him to take a week to consider what I had told him, and then by letter to inform me of the result. But he would not, however, hardly allow me to finish what I had to say, and expressed a firm determination not to alter his will, adding that I had five sons to provide for. After a short pause he implied (but unfortunately he here became very confused and forgot a word, which on subsequent reflection I think was probably 'reversionary')—he implied that there was a chance, whether good or bad I know not, of his becoming possessed of some other property, and he finished by saying distinctly, 'I will bequeath this to Huxley.' What the amount may be (I fear not large), and what the chance may be, God only knows; and one can not cross-examine a man about his will. He did not bind me to secrecy, so I think I am justified in telling you what passed, but whether it is wise on my part to send so vague a story, I am not at all sure; but as a general rule it is best to tell everything. As I know that you hate writing letters, do not trouble yourself to answer this.

P. S.—On further reflection I should like to hear that you receive this note safely. I have used up all my black-edged paper.

To Anthony Rich.

Down, Feb. 4th, 1882.

It is always a pleasure to me to receive a letter from you. I am very sorry to hear that you have been more troubled than usual with your old complaint. Any one who looked at you would think that you

* Anthony Rich (1804?–1891). Educated at Caius College, Cambridge, of which he was afterwards an Honorary Fellow. Author of *Illustrated Companion to the Latin Dictionary and Greek Lexicon*, 1849, said to be a useful book on classical antiquities. Mr. Darwin made his acquaintance in a curious way—namely, by Mr. Rich writing to inform him that he intended to leave him his fortune, in token of his admiration for his work. Mr. Rich was the survivor, but left his property to Mr. Darwin's children, with the exception of his house at Worthing, bequeathed to Mr. Huxley.

had passed through life with few evils, and yet you have had an unusual amount of suffering. As a turnkey remarked in one of Dickens' novels, 'Life is a rum thing.' As for myself, I have been better than usual until about a fortnight ago, when I had a cough, and this pulled me down and made me miserable to a strange degree; but my dear old wife insisted on my taking quinine, and, though I have very little faith in medicine, this, I think, has done me much good. Well, we are both so old that we must expect some troubles: I shall be seventy-three on Feb. 12th. I have been glad to hear about the pine-leaves, and you are the first man who has confirmed my account that they are drawn in by the base, with a very few exceptions. With respect to your Wandsworth case, I think that if I had heard of it before publishing, I would have said nothing about the ledges; for the Grisedale case, mentioned in my book and observed whilst I was correcting the proof-sheets, made me feel rather doubtful. Yet the Corniche case shows that worms at least aid in making the ledges. Nevertheless, I wish I had said nothing about the confounded ledges. The success of this worm book has been almost laughable. I have, however, been plagued with an endless stream of letters on the subject; most of them very foolish and enthusiastic, but some containing good facts, which I have used in correcting yesterday the 'sixth Thousand.'

Your friend George's work about the viscous state of the earth and tides and the moon has lately been attracting much attention, and all the great judges think highly of the work. He intends to try for the Plumian Professorship of Mathematics and Natural Philosophy at Cambridge, which is a good and honourable post of about £800 a year. I think that he will get it when Challis is dead, and he is very near his end. He has all the great men—Sir W. Thomson, Adams, Stokes, etc.—on his side. He has lately been chief examiner for the Mathematical Tripos, which was tremendous work; and the day before yesterday he started for Southampton for a five-weeks' tour to Jamaica for complete rest, to see the Blue Mountains, and escape the rigour of the early spring. I believe that George will some day be a great scientific swell. The War Office has just offered Leonard a post in the Government Survey at Southampton, and very civilly told him to go down and inspect the place, and accept or not as he liked. So he went down, but has decided that it would not be worth his while to accept, as it would entail his giving up his expedition (on which he had been ordered) to Queensland, in Australia, to observe the Transit of Venus. Dear old William at Southampton has not been very well, but is now better. He has had too much work—a willing horse is always overworked—and all the arrangements for receiving the British Association there this summer have been thrown on his shoulders.

But good Heavens! what a deal I have written about my sons. I have had some hard work this autumn with the microscope; but this is over, and I have only to write out the papers for the Linnean Society. We have had a good many visitors; but none who would have interested you, except perhaps Mrs. Ritchie, the daughter of Thackeray, who is a most amusing and pleasant person. I have not seen Huxley for some time, but my wife heard this morning from Mrs. Huxley, who wrote from her bed, with a bad account of herself and several of her children; but none, I hope, are at all dangerously ill. Farewell, my kind, good friend.

Many thanks about the picture, which if I survive you, and this I do not expect, shall be hung in my study as a perpetual memento of you.*

* Charles Darwin died on April 19, 1882, in his seventy-fourth year.

THE VIENNA ACADEMY OF SCIENCE.

By EDWARD F. WILLIAMS,
CHICAGO, ILL.

EARLY in the fifteenth century scholars on the continent of Europe began to discuss questions in little companies out of which grew what are now known as academies of science. At first these societies were made up of thoughtful men who met to compare their ideas on questions and discoveries which were exciting universal interest. The Academia Pontaniana in Naples was organized in 1433; the Academia Platonica in Florence in 1474. The proceedings in these academies were for the most part open to the public, and the work accomplished through them became the means of the formation of the academies of science, which, in most of the capitals of Europe, have filled so prominent a place the past century and have done so much to utilize and spread abroad historical, philosophical and scientific knowledge.

The history and the work of one of these academies, that in Vienna, will, it is believed, be of interest.

A private academy, the Literaria Sodalitas Danubia, started in Ofen in 1490 by Konrad Pickle, a Frenchman known as Celtes, was moved to Vienna in 1497, where it received into its membership philosophers, jurists, doctors of medicine and privy councillors. Its prime object was declared to be to broaden out 'the Humanism' of the time. It continued to prosper while Celtes was its directing spirit, but after his death in 1508 its influence gradually declined.

Early in the eighteenth century Leibnitz was anxious that an academy should be established in the Austrian capital, similar to the one which in 1700 he had persuaded the King of Prussia to organize in Berlin.

The central position of Vienna, the prestige of the Austrian government and the low estate into which universities all over Europe had fallen led him to visit the city and seek aid from those in authority in carrying out his project. Although his plans received favorable attention, wars with the Turks, opposition from Roman Catholics, especially from the Jesuits, and the difficulty of obtaining means for the support of an academy prevented their execution. Still Leibnitz persisted in urging his plans, and on his fifth visit in 1712 began to be confident that the greatly needed academy would soon be organized. His death the following year led to the abandonment of the project for the time. A Leipzig professor, by the name of Gottsched, in 1749

sought to revive the plan of Leibnitz, but although courteously received nothing came from his efforts. He wanted to be a professor in the university and president of the academy, but the fact that he was a protestant undoubtedly stood in his way. Still others than he were interested in the establishment of an academy. A plan presented by Baron von Petrasch in 1746 at the request of Count Haugnitz was laid before the government in 1750 and carefully considered. Under the terms science and the fine arts it proposed to cover the whole field of knowledge. Nothing came of this effort nor of another put forth in 1774, perhaps because the government feared the influence of the union of men so prominent for learning and ability, and perhaps because it did not see whence the means for its support were to come. The project for an Academy was not taken up again in earnest till 1837, when twelve men met in Vienna to talk the matter over. They recognized and emphasized the fact that in most of the large cities on the continent academies had been founded not only to the benefit of their members but to the credit of the cities in which they had their seat. Patriotism, they insisted, required the union of the scholarship of Vienna in an academy as a channel of communication with the learned world. As all who met to discuss the formation of an academy were of one mind as to its necessity, they formulated a plan of work, suggested means for its support and signed a petition to the government for its immediate organization. A small stamp tax on certain articles and the right of the academy to publish a calendar would, they thought, produce the necessary funds. The petition was seriously discussed. Men high in office, of noble birth and near the emperor were in favor of granting the request. The plan now presented was compared with that drawn up in 1750. Public sentiment as represented by the learned class was tested. The professors in the university were asked for their opinion. Some thought there were already too many institutions in the city and that there was neither room nor place for another. The medical faculty as a whole was not in favor of an academy. Some thought its work could not fail to come into conflict with that of the university. But the dean of the faculty of arts, Professor J. J. von Luttrow, wrote that the two could not come into conflict, that a university is a place for imparting knowledge already acquired and tested, while an academy seeks to increase knowledge by investigations and discoveries and furnishes a place where scientific men may compare their theories, criticize them and weigh carefully and judicially the evidence upon which they have been formed. For years the discussions about the forming of an academy continued. The matter was referred, in May, 1838, to a special commission formed by the court. This commission reported favorably in June of the following year. Nothing however was really done till 1847, although several commissions had meanwhile been

appointed and without exception had reported that they looked upon the project of an academy with approval. Tired of waiting the movements of the government, a private academy was organized in January, 1846. Its members favored an academy with two classes, historical philosophical, and mathematical scientific, and did their work along these lines. When the petition for the formation of an academy reached the prime minister, Metternich, he simply said that it was unnecessary as he had long since determined to found an academy and had secured a plan for it. From its discussions he proposed to exclude theology, literature, politics and ethics, and limit them to the subjects connected with positive science. In presenting his plan to the emperor, which received his approval, the minister said that the conservatism of the academy would counteract prevailing disturbances in thought, especially in politics, and furnish a center around which monarchical ideas would crystallize. It was decided that a prince of the reigning house should be curator, that the president should be a nobleman, that there should be 48 active members, as many corresponding members, and one public meeting a year; that the cost should be borne by the government, but must be limited to 40,000 gulden annually; that for each of the two classes a secretary should be chosen, to whom, with the dean and the president, small salaries should be paid, but that ordinary members should receive nothing, inasmuch as many of them, professors in the university and in other offices, were already in the service of the government. Final and favorable action was taken in November, 1847, though the formation of the academy had been officially announced in May of that year. The Academy consisted of 40 active members, 18 of them resident in Vienna, the others representing various sections of the realm. Many reasons prevented the curator, Archduke John, from issuing a call for the meeting of the academy till February, 1848. It had been agreed that in addition to the forty members named by the emperor out of the lists furnished him, these forty should have the privilege of choosing eight more members and, subject to the emperor's approval, of electing its president, its secretaries and its dean. The cost of printing the papers presented to the academy was to be met by the government, but to the request that these papers be free from police supervision a negative answer was returned. This was in the revolutionary year 1848. The day after the request for freedom of publication had been denied a mob gathered in Vienna, the emperor surrendered his absolute power and granted the academy the liberty it desired. He also permitted the academy to increase its membership, by 12 in each class, and to elect an equal number of corresponding members. Though providing amply for the study of history and philosophy, the first place was given to science. Hammer Purgstall was chosen the first president. "An academy," said he, "is a union of

spiritual forces for the advance of knowledge in its highest development and power. It does not busy itself with the instruction of youth but with protecting and stimulating men of learning. It is a sort of judgment seat to which scientific attainments are brought and at which their real value is appraised."

Though hesitating so long over the establishment of an academy, having permitted its organization, the government did not fail to favor it in every possible way and to provide handsomely for its support. Rooms were set aside for its sessions and its work, in the Polytechnic Institute. Since 1857, it has had a home of its own in a building long used as barracks for soldiers, but designed, according to tradition, by the Empress Maria Theresa for the academy which she herself intended to found. Here the general secretary resides, and as the building is very large, several scientific societies have courteously been granted shelter. The correspondence of the members of the academy within the realm goes free. Save in the summer months, sessions are held every week and, with the exception of a single meeting each month, the different sections of the academy meet by themselves. The proceedings of the meetings fill many volumes and form a collection of scientific, historical, philosophical and archeological papers of almost inestimable value. Twenty-four active members now reside in Vienna. Strangers properly introduced are permitted to attend the sessions of the academy, though none of these sessions are open to women.

The means at the disposal of the academy, though they cannot be given with absolute accuracy, are for an institution of the kind quite large. They make it clear that its members have the confidence of the public and that the work they are doing appeals to men of wealth and lovers of learning. From the sale of an almanac which contains brief reports of the proceedings of the academy the profits are not inconsiderable. Extraordinary grants from the government and gifts from rich men have from time to time been made for special purposes. That infirm officers of the academy may receive pensions, since 1898 the government has given 50,000 gulden annually, instead of the 40,000 previously received. To this sum are added 20,000 gulden for printing, and 7,000 gulden to each class for pressing needs. Property left to the academy for prizes, or to be used in any way which in the judgment of its members will increase knowledge and promote its diffusion, now produces a large income. Since 1890, Prince John of Lichtenstein has given 5,000 gulden annually for excavations in Asia Minor, and since 1900 has doubled the amount.

Experience has convinced the academy that the giving of prizes is not the best way to use money. Only such are awarded as are made necessary by the terms of a bequest. The offer of prizes, it is affirmed, only stimulates a man who has work in hand to complete it, but rarely

induces one to begin new work or to enter upon investigations which may result in important discoveries and valuable additions to human knowledge. So far as possible the income of the academy, which is now between forty and fifty thousand dollars a year from its own funds, is employed in subventions, to aid in printing important treatises, for travel, for excavations or special work. A brief reference to what has been accomplished will justify the demands of the friends of the academy for its establishment. It has provided for the publication of the 'Corpus Scriptorum Ecclesiasticarum Rerum' in many volumes and of many volumes of reports of the excavations of the prehistoric commission for whose work it furnished the means. It has nearly completed the petrographic study of the central chain of the Eastern Alps, and has made a map of the region. In 1894 it joined in an international enterprise to discover the weight of the earth. In 1897 it sent, at a cost of more than 20,000 gulden, an expedition to Bombay to study the bubonic plague. Its bacillus was discovered, but the young man in charge of the expedition lost his life. In 1898 and 1899, it had a commission at work in southern Arabia, and on the island of Socotra. In 1897 it completed deep sea soundings in the Mediterranean, especially in what is called the Adriatic Sea. In 1899 it sent a double expedition to India to study meteors and the eclipse and in 1891 it sent a botanic expedition to Brazil. The results of all these expeditions and of others almost as important have been carefully edited and given to the world through the press.

In 1901 36 annual 'advertisers' had appeared and 49 'almanacs.' These were filled with information not elsewhere to be obtained. At that time the philosophical class had published 48 volumes of works prepared under its direction and 141 volumes of 'Proceedings.' The scientific class had published 68 volumes of special treatises and 108 volumes of 'Proceedings.' Five parts of the 'Report of the Prehistoric Commission' had also appeared. For twenty years and more monthly reports of the condition of chemistry in Europe and throughout the world have been printed and circulated. Of the 'Archives for Austrian History' 88 volumes have appeared, of the 'Sources (Fontes) for Austrian Affairs,' 8 volumes in the First Part, 51 in the Second Part; of 'Announcements from the National Archives,' 2 volumes, of the 'Monumenta Concilliorum,' 2 volumes, and 4 volumes of Part III. Of the 'Hapsburg Memorials,' divisions two and three of Vol. I. have been printed and one part of Vol. II. Ten volumes of the 'Tables of Codices' have appeared, three of the 'Venetian Dispatches' and the second division of Vol. II.

The Academy claims to have suggested and obtained the appointment of a committee to consider the sources of Indian lexicography; to investigate the condition of the Corpus Scriptorum of Oriental

knowledge; to look after Grecian grave inscriptions and to create a commission for the study of oceanography. It shares with the Berlin Academy and with the academies of Munich, Göttingen and Leipzig in the preparation of a Latin dictionary. The work is done in Munich and on a scale which may require twenty years to complete. Together with the academies of Munich, Göttingen and Leipzig, it has carried through and nearly completed an 'Encyclopedia of Mathematics and Related Knowledge,' and has agreed to join with them in the future in any work which ought to be undertaken, but which is too large for the resources of a single academy. It joined the international association of academies in 1900, and is taking part in the publication of the international catalogue of scientific literature. Statements by the secretary of what was done during the year 1899–1900 show the great place the academy now fills. The Prehistoric Commission, he says, continued its investigations at Töplitz near Krain, and discovered in graves which had never been opened many articles belonging to a prehistoric race. The work is nearly complete and full reports of it will soon be published. Successful efforts have been made to obtain a complete collection of objects needed for the 'Phonographic Archives' of the academy. The third part has been published of the report of the Austrian Plague Commission on the morphology and biology of the bacillus, and on the means to be used for the disinfection of man and beast and their future protection against danger from this source. A report of the visit to India to photograph meteors and observe the eclipse has been printed. Opportunity was taken during this visit to secure measurements of the intensity of the sun's heat and to collect twenty specimens of orchids. The petrographic survey of the Alps has been continued and provision made for publishing part A of Vol. VI. of the 'Mathematical Encyclopedia.' The material is in hand for nearly all the work. The Earthquake Commission has made observations in Istria and Dalmatia, in Krain and Görz. The number of earthquakes studied is 190, in the previous year 209. Reports from several hundred meteorological stations have been received and tabulated for use not only in the study of meteorology but for the study of terrestrial magnetism.

Under the patronage of the 'historical class' of the academy important publications have been brought out on the early history of Austria-Hungary. Some new historical facts have been discovered during the year. Work on the edition of the Latin church fathers has continued, and the writings of Arnobius Minor have been worked over by J. Schnarnagl, those of Cæsar Arelatorius by G. Morris, those of Prudentius by J. Bergmann. It is hoped to get these writings into such shape as to make them valuable. The collection of manuscripts belonging to the library, through the aid of other libraries and by pur-

chase, has been greatly increased. As the result of an archeological journey to Permesos in Pisidia nine graves, differing in type from any yet opened, were carefully examined. Vol. I. of this report has now been published.

The Academy is trying to obtain for its 'Phonographic Archives': (1) Exact representations of the sounds of European languages and dialects at the beginning of the twentieth century, (2) representations of the best musical accomplishments of the present time and of the musical productions of peoples of different degrees of culture as a basis for comparison, (3) representations of the tones of the voices of distinguished men. These tones the phonograph will preserve. The results of the expedition to southern Arabia and Socotra will soon appear in a large number of volumes, giving an account of reptiles, fishes, insects, lepidoptera, diptera, coleoptera, neuroptera, etc. The gains for linguistics and epigraphy are said to be very great.

The study of the results of the commission to India to gather information in regard to the cause of the bubonic plague has discovered its bacillus and made it possible to prevent the spread of the plague in the future. An essay on 'Die Porcia von Socotra,' published by the academy, has pointed out the possible relation of this Porcia to the Portia of Shakespeare. Several tales current among the people of Socotra and on the coast were carefully written down and will not only show how stories of this character travel from country to country, but will add to our knowledge of folk-lore. Work which promises to be of importance has been done in the study of the syntax and philology of the Slavic languages, and several publications have appeared on the political history and philosophy of the Slavic peoples. The Academy is attempting to investigate and study accurately the history, archeology, philology and ethnology of the entire Balkan peninsula.

The archeological work of the academy proved to be of such importance and extent that a special society was formed to carry it forward. Explorations in Ephesus were made in 1897, preliminary reports of which have appeared, and also of work done in Cilicia. In the spring of 1898 measurements were made in Luxor, Egypt, to determine the influence of winter climate on atmospheric electricity, in Siberia to discover the influence of extreme cold, and in a balloon at the height of 4,000 meters. The Academy has taken part with the German academies in preparing an Encyclopedia of Mohammedanism and it shares with the academies of Berlin and Munich the income of the Savigny bequest for the study of Law, German and Roman, and the law of all nations. The subventions, which cover almost every department of scientific research, and those made for historical and philosophical purposes, over fifty in number, now exceed in amount 75,000 florins annually. They indicate an activity in research equaled by no

other academy save that of Berlin on the continent and are producing results in which the members of the academy may justly take great pride.

In closing this brief account of what a single academy of science on the continent of Europe has done, it may not be out of place to add that, as the work of the academy has expanded, other societies, chiefly scientific or archeological, have grown out of it, thus proving it to be, as was predicted long before its formation that it would be, the mother of scientific and historical learning in Austria. The academy in Buda Pesth has larger resources of its own than the Vienna Academy and has pushed its work with untiring zeal. Barriers of language render the results of its work less accessible than those of the German academies. Two academies in Prague, one for the Germans of the city and of Bohemia, and one for the Czechs, both under the protection of the government and in receipt of grants from it year by year, have done excellent work, but on a smaller scale than at Vienna. Of lesser academies in various cities in the empire, or of learned societies it is unnecessary to speak, inasmuch as the Vienna Academy is the model which, so far as possible, all of them try to follow.

MENTAL AND MORAL HEREDITY IN ROYALTY, VIII.

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Evidence from Lehr's Genealogy.

IF there is any one still unconvinced that heredity is by far the most important of all causes leading to high mental activity resulting in what we call eminence or distinction, he need only carefully study the great book of pedigrees compiled by Paul Ernst Lehr. If he will follow these charts of relationship and, at the same time, use any general biographical dictionary, he will find how seldom has distinction, as judged by achievements, fallen to those not close blood relations of others of the same stamp. And this consanguinity of distinction is in spite of the varying degrees of education and opportunity that must have been presented to these different princes even when living in the same age or the same family. If we find, as we do on certain pages of the book, great barren regions containing dozens of titles of the highest social rank, the bearers of which lived in different countries and eras, there is no reason to suppose that these undistinguished princes did not average just as much opportunity as the average of dozens on some other page where clustered together are the names of those whose achievements have been the themes of biographers and historians.

For instance, there does not seem to be any reason why the kings and princes of Denmark should not have averaged just about the same opportunity as the princes of Prussia; education of varying degrees of perfection, stirring times and chances to display ability in war and government fell to the lot of a certain number in each country, certainly to no more in Prussia than in Denmark, yet Denmark is barren of genius, and Prussia at the same time is full of it. At that time not only do we find great men and women in Prussia, but also their relations in Brunswick and Sweden, engaged in vigorous activity, while the princes of nine tenths of the other countries of Europe are doing nothing really worthy of any mention at all, although education and events must certainly be favorable to a great many of them.

It is not that education is of no moment, for it must be, as we all know, of conspicuous influence in mental development. Even those 'self-made' men who have had no education worth mentioning in the ordinary sense of the word, have nevertheless educated themselves by observation and experience. It is not that education is of no moment, but it must be that the determining factor in the production of the

more important man, is not his education or his opportunities, but the inherent desire for knowledge and power that makes him *seek* an education in one way or another, while the mediocre man is not willing to have more thrust upon him than his native attention can stand.

Lehr's 'Genealogy' is a book compiled for purely heraldric purposes and traces to the twelfth degree of remoteness eight of the principal reigning families of northern Europe. Since in going back twelve generations every person has 4,096 ancestral quarterings, the total value of the material brought together in this way is $8 \times 4{,}096 = 32{,}768$, an immense field for the study of heredity. Owing to intermarriages the total number of different persons is considerably less than this, being 3,312, but it makes no difference from the standpoint of science whether we repeat the same person several times in the pedigree or whether another of the same characteristics is introduced in his stead, the scientific value of this book is represented by the larger number, 32,768. This is of course ignoring the possibility that inbreeding of itself creates a different value for the stock; but since inbreeding in these families is never very close, and since it is the best scientific opinion that inbreeding *per se* as usually carried on among human beings is of no consequence, other things being equal,* this error, if it be one, may be neglected.

A group of 32,768 persons, such as we have in the pages of Lehr, possesses several peculiar advantages for the study of the origin of genius. First, it is gathered together in an entirely impersonal way, Lehr having no scientific theory in view. Second, it contains also mediocrities, so that we may see how many times mediocrity has produced its like before any genius appears. Third, the exact relationship of every person to every other person is known, and the pedigrees are perfectly complete. Fourth, nearly all are of royal or noble birth, very few being below the rank of a count, so that although their environments are very different, their social position is always much the same.

Among all these 3,312 I found only sixteen worthy of the nine or ten grades here employed. These are given in the list below, the word (new) being appended to those whose immediate ancestry is devoid of others of equal intellectual worth.

1. (new) Anhalt: Catherine II., Empress of Russia.
   Catherine must be considered as a 'sport' in more than the popular use of the term, since her ancestry was in no way remarkable. She did not leave any descendants nearly as capable as herself.
2. Brunswick: Amelia, Duchess of Saxe-Weimar.
   'Distinguished patron of genius and learning.' Friend of Goethe. She was an excellent student, in which she showed 'wonderful perseverance' and also composed considerable music. Amelia was a niece of Frederick the Great and consequently closely related to about a dozen of the most brilliant of modern royalty.

* Conf. Huth, 'Marriage of Near Kin.' 8vo. London, 1887.

3. Castile: Isabella, the Catholic, wife of Ferdinand of Aragon.
   Isabella was probably a reversion due to the remarkable and repeated inbreeding from John of Gaunt, Duke of Lancaster and John the Great of Portugal. Her illustrious descendants were numerous. Among others may be mentioned the emperor Charles Quint, Don John of Austria and Alexander Farnese.
4. Coligny: Caspard, the great admiral.
   The great admiral was the product of the union of the Colignys with the Montmorencys when both families possessed illustrious names. He also left great descendants (Maurice of Nassau and others).
5. Henriette: poetess, a grand niece of the admiral.
6. (new) Douglas: Archibald Earl of Angus.
   Not a conspicuous example of heredity. His son Gavin was distinguished as a poet.
7. (new) Egmont: Lamoral, –1558.
   Had two sons of some distinction.
8. Hanau: Amelia, married William V. of Hesse-Cassel.
   As regent, 'extraordinary energy, wisdom and virtue.' William the Silent, the illustrious founder of the Dutch Republic, had thirty-two grandchildren, four of whom were distinguished. Amelia was one of these four.
9. Hohenzollern: Frederick William, the Great Elector of Brandenburg.
   True founder of the eminence of the Hohenzollerns and greatest man in Germany in his day. He was one of the numerous great grandchildren of William the Silent.
10. Lorraine: René II., Duke of, –1508.
    Defeated Charles the Bold. Mother was a daughter of René, Duke of Aragon (distinguished).
11. Lorraine: Claude, first Duke of Guise, son of the above. He served in the army with distinction at Marignano and other places, and was created Duke of Guise by Francis I. His fame was exceeded by his son, Francis, who became 'one of the greatest commanders of his time,' and also by his grandson, Henry, the bitter opponent of the Protestants.
12. (new) Orange: William the Silent, illustrious founder of the Dutch Republic. Sprang from comparatively mediocre stock, but his genius was wonderfully well perpetuated owing to his remarkably brilliant alliances.
13. Palatine: Sophia, Electress of Hanover, an undoubted example of hereditary talent, owing to her many brilliant relations, and one of the connecting links between the genius in the families of Orange and Hohenzollern.
14. Parthenay: Catherine, Vicomtesse de Rohan, –1631.
    "A spirited and gifted French lady, was a Huguenot. She distinguished herself at the siege of La Rochelle in 1627, and later published some poems." The famous Duke of Rohan was her son. He was called 'the perfect captain,' also wrote valuable memoirs and a treatise on war. The father and aunt were both distinguished.
15. (new) Romanhof: Peter the Great of Russia.
    It is a question whether Peter is to be regarded as a new variation or a reversion to his great grandfather, Feodor, who was the greatest man in Russia in his day. His only other very brilliant relation was Sophia, his half sister.

16. (new) Vasa: Gustavus I., illustrious founder of the dynasty. Certainly a new variation. Genius amply inherited in Gustavus Adolphus and others.

These are all the great names found among 3,312. All the quotations are taken from Lippincott's 'Dictionary,' so the work has an entirely impersonal basis. In considering the remaining, 3,296, who, as far as Lippincott's great dictionary is concerned, have left no lives worthy of distinguished merit, we gain an insight into the rarity of such men and women as the Great Elector of Brandenburg or Catherine Parthenay. What of these 3,296? Can it be possible that, living in the highest social position as they did, a very large majority of them did not have abundant opportunities to exercise ability had they been the possessors of it.

What is to be said on the side of heredity? It will be seen that at least seven of these sixteen numbers (2, 4, 5, 8, 9, 12, 13) belong in what may be called the great main mountain chain of royalty, composed of the families Condé, Coligny, Montmorency, Orange, Palatine and Hohenzollern, whose course can be traced from Anne de Montmorency 1493–1562, as far as one generation beyond Frederick the Great in the beginning of the nineteenth century.

Of the other nine, Catherine II. of Russia, alone gives no striking proof of heredity. It is examples of this sort that should be most frequent were environment the main cause. Since wars have been going on during most of the period covered in this book, and since the majority of princes have had positions in the army and cabinet, and have been given fair educations, and since the effects of environment must have been mostly questions of chance, apart from family influence, there does not seem to be any reason why environment should group the great ones together in any way except as regards time or place. But these sixteen are not grouped as regards time or place, but are scattered over the centuries and in various countries. If more than ninety per cent. of them are compatible with all that can be expected from heredity, and the chances are tremendously against such an occurrence owing to the large preponderance of mediocrity, then we must conclude that heredity is far more important than environment in the causation of the above facts.

About half the number are new variations. This is pretty well in line with results in the study of genius in general. That is, the vast horde of mediocrities is just about as likely to produce a great man as the relatively small number of great are likely to perpetuate their own kind. The reason why genius for war and government was maintained through more generations than scientific or literary genius ever has been is probably simply this: leading families in science and art do not in general intermarry in the way that these great governing

families have done. Some exceptions to this may occur, as among the descendants of Jonathan Edwards and the famous musician, Bach, but in these cases the mental qualities were perpetuated.

In the lower forms of animal life we know by actual experimentation that slight changes in the environment occasion the greatest difference in results, still in spite of the strange modifications that may be occasioned in the developing fish or frog by external mechanical or chemical means, the question resolves itself under ordinary conditions to the nature of the primary germ-cells.

If a naturalist were stocking two tanks, one for fishes and one for frogs, and had eggs of both to use for that purpose, the first practical question for him would be—which are the eggs of fishes and which are the eggs of frogs?

It is just so in the development of the human mind. As far as the practical results are concerned, the one bit of knowledge, the possession of which will best enable us to predict the fully developed adult, is an answer to the same sort of question as that we would first wish to know in the case of the fishes and the frogs. What is the nature of the primary germ-cells? Since for obvious reasons we can not know this nature, the next best thing to know is its theoretical probabilities as derived from a proper study of the ancestry.

It would seem from the facts here studied that the probabilities will be roughly as given below. Quality possessed by entire ancestry is almost sure to appear. Quality possessed by one parent and half the ancestry is likely to appear with almost equal force, in one out of every two descendants. Quality possessed by one parent only, and not present in the ancestry, has one chance in about four for its appearance in the progeny. Quality not possessed by either parent, but present in all the grandparents and most of the remaining ancestry, would also have about one chance in two for its appearance in one of the children. If only one of the great grandparents possessed the quality in question, then the chances of its appearance in any one of the grandchildren of this ancestor would be only about one chance in sixteen. It would be, however, very unlikely that some of the remote ancestry had not also the quality in question, so the chances would be raised in a greater or less degree according to the proportionate amount of this remote influence.

There does not seem to be the least reason for assuming that the male side is any more or less potent than the female side in the transmission of family characteristics, nor does there seem to be any grounds for the fancied belief that sons tend to resemble their mothers and daughters their fathers, or the more generally accepted scientific belief to the contrary. No figures have been compiled on this subject

because it has seemed to the author to be profitless in view of the approximate equality of the instances *pro* and *con*.

The above estimates for the characteristics of offspring are in accordance with Galton's law of ancestral heredity, except that provision is made for the fact that *mental and moral qualities do not freely blend, so that a child is apt to 'take after' pretty completely some one of his ancestors, more often the near one, less and less often the remote one,* until the chances of reversion to a very distant one are exceedingly slight.

Once in a large number of times occurs one of those fortuitous* combinations of ancestral qualities that is destined to make a person inheriting them vary much from any of his kind, and in fortunate instances shine as a genius, springing from a mediocre stock. The figures drawn from Lehr's 'Genealogy' were about one in five hundred for this sort of occurrence.

At this point it may be well to consider a popular misconception concerning the value of hereditary influence—a mistake very frequently made. Many people argue that great geniuses, coming as they frequently do from humble families, Franklin and Lincoln for instance, discount our belief in mental heredity; when, on the other hand, these men should only strengthen our reliance in this same force. We should consider the thousands, indeed millions, of mediocrities, who have to be born from mediocrities, before one mind of the type of Franklin's is produced.

That they rise superior to their circumstances is in itself a proof of the inborn nature of their minds and characters. A man of this sort represesents just the combination of the best from many ancestors. It would be possible in a great many throws to cast a large number of dice so that they would all fall aces. But here in certain regions of royalty as among the Montmorencys and Hohenzollerns where the dice are loaded, such a result may be expected in a large percentage of throws.

* It is to be remembered that when we speak of chance as a cause of the combinations of characteristics, that even the throwing of dice or pitching of pennies is entirely subject to the laws of mathematics, as has been abundantly proved by experiments. (Conf., K. Pearson, 'Chances of Death,' etc.)

HIGH-GRADE MEN: IN COLLEGE AND OUT.

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THE American college graduate has often been called upon to face the accusation of impracticability. From time to time men of wide influence and broad experience have censured not only his ideals, but his fitness for participation in those affairs which count for most in a modern civilization. The burden of their complaint is that he is a dreamer of dreams, not a doer of deeds, and that there is little place for him in the strenuous competition of the life of to-day. Such accusations are gradually becoming less and less frequent. Enough has been written upon the subject to prove the general falsity of the position, and no further defense is needed of college men as a class. It can not, however, be denied that as individuals college graduates meet, with very different degrees of perfection, the demands of life. Some take first rank in their chosen callings; others see their efforts crowned only with moderate success, while another, and we believe a smaller class, make partial or total shipwreck of their hopes. But this differentiation and stratification which is so noticeable in the struggle for honors in the various competitions of business and professional life was equally true for them during their undergraduate courses. In the student body of every institution of learning we find the high-grade men, the moderate successes, from the standpoint of college education, and the rear guard. A question of no little importance, and one with which the present paper deals is this: Is the high-grade man of his college days high-grade still when put to the severer tests of active life? Is the level to which he rose or sank in competition for college honors his level for life, or is there a general shifting of strata for the changed conditions? The answer to these questions is of broad educational significance. It has to do with ideals: those of the college and of life. The high-grade man in college has realized most nearly the ideal of his alma mater. He is its best product according to its criterion of success and is given its highest stamp of approval. If he fails in life, it means that judged by another criterion—that of society in its broadest sense—he is not a success; that the two criteria are different, based upon different ideals, and, as a corollary, since life is the final test, that the college ideal is not a practical one and that the aim of higher academic education is false. If, however, he holds first place in life, as he did in the preparation for it, we must conclude that the two ideals, that of the college and

that of the civilization of which it forms a part, are coincident; that, in terms of the ultimate test, the college ideal is a good one.

The present study is an attempt to follow the subsequent careers of high-grade college men in order to determine their evaluation by the world at large. It presupposes two criteria, each of which must be arbitrarily chosen, one for high grade or success in college, and the other for achievement of the same character in after life. As the former criterion, I have taken membership in Phi Beta Kappa, the honorary, college Greek letter fraternity; as the latter, mention in 'Who's Who in America' the annual biographical cyclopedia published in Chicago.

There can be, I believe, little question as to the validity of the first criterion. Election to Phi Beta Kappa is based upon marks given in course, only the high-grade men (and women) being admitted, and so far as I know, no complaint has ever been made as to the justice of election on this basis. There are at present fifty chapters of the fraternity in the colleges and universities of our country. Only students matriculated for the bachelor's degree are elected and of the entire membership 85 per cent. or more have received it in arts; the remainder in science or philosophy. This eliminates from our study the professional, technical and graduate schools and reduces it practically to the academic institutions of higher grade: in fact, the typical American college whose *raison d'être* has been more boldly questioned than has almost any other part of our educational machinery. The percentage of graduates elected to Phi Beta Kappa by the different chapters varies, being as low as 8 per cent. for Harvard and as high as 33 per cent. for several other colleges, with an average of about 16 per cent., or one graduate in six, for the whole. It is, then, this upper stratum of college men which we are considering in this study.

The criterion of success in after life which I have made use of is perhaps not so free from valid criticism. It is possible that not all would wish to accept mention in 'Who's Who' as indicative of high grade in life, yet with all its shortcomings, I know of no better criterion of success that can be applied to large numbers of living Americans. Although the names of many men and women of eminence fail to find place on its pages, it is nevertheless probably true that each who is there mentioned has achieved more than an ordinary degree of success in the chosen calling and is, therefore, entitled to be classed as high grade.

The volume chosen for the purpose of the present study was that for 1900, since it was contemporary with the 'Handbook and General Address Catalog of Phi Beta Kappa,' compiled by the Secretary, Reverend E. B. Parsons, of Williamstown, Mass., which is used in connection with it. The volume referred to contains the names of 8,602 living Americans, from every calling and profession. Of this number 3,237 are college graduates, with degrees from more than 200 institutions.

A classification of the names in it, in terms of the various professions and vocations, gives us the following numbers for the twenty-four which seem to form the most natural divisions. *Actor:* male 54, female 40. *Artist,* including illustrators: male 260, female 21. *Author,* including writer, historian, novelist and poet: male 528, female 272. *Business,* including the various mercantile pursuits: male 200. *Clergyman,* including bishop, rabbi, missionary, priest, salvation army and monk: male, 655, female 7. *College professor,* including president, dean and chancellor: male 1,090 female 11. *Congressman* (both senate and house), 446. *Editor,* including journalist, critic, correspondent and reporter: male 509, female 13. *Educator,* including superintendent, teacher, philanthropist and reformer: male 188, female 30. *Engineer,* including architect and miner: male 284. *Financier,* including capitalist and banker: male 215. *Inventor:* male 26. *Lawyer,* including justice, judge, and jurist: male 857, female 4. *Lecturer:* male 21, female 6. *Librarian:* male 362, female 9. *Musician,* including singer: male 111, female 21. *Physician:* male 540, female 7. *Railroad official:* male 102. *Sailor:* 103. *Scientist,* including naturalist: male 416, female 7. *Soldier:* 205. *Statesman,* including governor, diplomat, politician and mayor: 202. *U. S. official:* male 98, female 1. *Miscellaneous,* running all the way from farmer to insurance president: male 53, female 2. This classification is given in order to show that there is nothing in the nature of the work to make it draw more largely from the class of high-grade college men than from the low because of any limitation of calling.

The method of the present study is as follows: First, those colleges were selected which have had a chapter of Phi Beta Kappa for at least twenty years previous to 1900; and graduates only of those colleges are considered. This selection was made because of the fact that very few young men find place in 'Who's Who,' and recent graduates are practically excluded because of a virtual age limit. We have then as the basis, the twenty-two colleges mentioned in the table (*a*). Next, by reference to the 'Phi Beta Kappa Handbook,' the exact number of living members of each chapter were ascertained (*b*), 8,122 for all. Then by means of a comparison of these names in the 'Phi Beta Kappa Handbook,' with those in 'Who's Who,' the number for each chapter found in both was determined (*c*), *i. e.*, the number of Phi Beta Kappa men in 'Who's Who,' or the number of high-grade college men who maintained a high grade in after life, according to our criterion. The next column of the table (*d*) shows the percentage of such for each college, which percentages form one term of a comparison. The other term was determined as follows: By various means, though largely through the use of the 'World's Almanac for 1901' (figures for 1900), the total number of living alumni for each of the twenty-two colleges of our

list was determined and then, by a complete tabulation of all the names in 'Who's Who,' the number from each college who found mention there, ascertained, *i. e.*, the number of the rank and file—high-grade and low—who were high grade in the ultimate evaluation. These numbers are not given upon the table, but the percentage of such for each college is in column *e*. In the two columns, *d* and *e*, we have the basis of what seems to me an important comparison, the first representing the percentages of high-grade college men who were successful in life according to our criterion, and the second the percentage of good, bad and indifferent college men who achieved success in terms of the same criterion. The averages at the bottom of these columns are very expressive: 5.9 per cent. for the former to 2.1 per cent. for the latter. If we are to accept these figures, our conclusion must be that the Phi Beta Kappa man's chances of success are nearly three times those of his classmates as a whole; that the upper stratum of college life is the upper stratum still when put to the test and, to borrow further from the nomenclature of the geologist, the cataclysm of graduation does not produce a subversion of strata. An examination of the table shows that for only five of the colleges studied was the percentage of success for

Colleges.	Living $\phi\beta\kappa$ Graduates.	$\phi\beta\kappa$ Graduates in 'Who's Who.'	Per cent. $\phi\beta\kappa$ Graduates in 'Who's Who.'	Per cent. Living Graduates in 'Who's Who.'	Per cent. Elected to $\phi\beta\kappa$.	Per cent. of 'Who's Who' Men Elected to $\phi\beta\kappa$.
a.	*b.*	*c.*	*d.*	*e.*	*f.*	*g.*
Amherst	630	29	4.6	2.6	20	40.3
Bowdoin	358	36	10	2.2	25	59.8
Brown	658	22	3.3	1.8	25	52.4
Colgate	184	4	2.1	1.7	25	57.1
Columbia	310	21	6.7	.8	20	39.6
Cornell	212	11	5.2	1.6	12	30
Dartmouth	650	38	5.8	2.4	16	45.2
Hamilton	366	9	2.4	3		45
Harvard	1110	139	12.5	2.7	8	40.8
Hobart	135	2	1.5	2.6	25	40
Kenyon	140	3	2.1	3.6		33
Marietta	175	1	.6	1.1	33	33
Middlebury	135	3	2.3	3.3	33	30
N. Y. City Col.	185	2	1.1	.8	12	10
N. Y. Univ	190	6	3.1	.4		42
Rutgers	285	5	1.7	1.6	25	83
Trinity	225	12	5.3	4.1	33	40
Union	360	23	6.4	3	25	34.3
Wesleyan (Conn.)	375	21	5.6	3.4	25	47.7
Western Res	140	5	3.6	.4		45.5
Williams	435	33	7.6	2.8	20	54.1
Yale	864	56	6.5	2.3	12	24.5
	8122	Tot. 481	Av. 5.9	Av. 2.1	Av. 15.7	Av. 39.3

the graduates as a whole (*e*) greater than for their high grade men (*d*), and these colleges had so few alumni mentioned in 'Who's Who' as to give their figures but little weight in a statistical study of this nature.

The names in the two books furnishing our data, considered in still another relation, tend to corroborate the conclusion already arrived at. In column *f* of the table is shown the percentage of graduates which each college, so far as I have been able to secure the figures, elects to Phi Beta Kappa. It will be seen that there is no common custom and that the variation is considerable. Each represents, however, the proportion of high-grade men, according to our criterion, among its living alumni, and, consequently, the proportion we might expect to find among its representatives in 'Who's Who,' if high grade in college has nothing to do with one's expectancy of place in that book. The average percentage of such for all the colleges considered, as shown at the foot of the column, is 15.7.* The next column, however (*g*), shows the percentages of such men who have actually received such honorable mention, and in the two we have the basis for another comparison: that between representation based upon the numerical expectancy of the high-grade college men (an average of 15.7 for all the colleges) and upon their actual achievement (39.3 per cent.). The comparison is certainly an encouraging one to the high-grade men, showing as it does that they have surpassed their mathematically computed expectancy by more than 150 per cent.

I have been able, through the courtesy of officers connected with two of the larger New England colleges, to supplement this study of Phi Beta Kappa graduates by one based upon the exact standing in class, of each one of their alumni mentioned in 'Who's Who.' This enables us to determine not only the percentage of high-grade men receiving mention, but also the distribution of the rest through the lower grades of the class. I had hoped to make this study cover a larger number of institutions, but have been unable to secure the data. The figures for the two are as follows:

Total number of living alumni	13,705
Total number mentioned in 'Who's Who'	303
Percentage mentioned in 'Who's Who'	2.2
Percentage mentioned, of those who graduated in first tenth of class	5.4
Percentage mentioned, of those who graduated in second tenth of class	2.9
Percentage mentioned, of those who graduated in third tenth of class	2.5
Percentage mentioned, of those who graduated in fourth tenth of class	1.8

* Percentages in the column 'weighted' in terms of living graduates.

Percentage mentioned, of those who graduated in fifth tenth of class	1.8
Percentage mentioned, of those who graduated in last half of class	1.9

As may be seen from these figures, 2.2 per cent. of the rank and file of the living graduates of these two institutions achieved 'Who's Who' success, and we might with reason expect this percentage to hold true for each tenth of the classes, provided scholarship has nothing to do with honors subsequent to graduation. What we do actually find for the separate tenths is shown lower down in the column of percentages; for the first tenth of the class, considerably more than double the expected number; for the second and third tenths, slightly more than expectancy, and for the remainder of the class, considerably less. These percentages are based upon the supposition that mortality has been equal throughout the class and that one tenth of the living alumni were graduated in each tenth of the class, based upon scholarship. It will be seen from the figures that the percentage of success is a little greater for the last half of the class, based upon marks, than for the tenths just preceding it. This fact is even more pronounced for those who graduated practically at the foot of the class, although my figures covering that portion are not sufficiently accurate to form the basis of percentages for the tenths considered separately. I know of no way to account for this, unless it be that those students who were able to keep a foothold among their classmates only with the greatest difficulty, gave up all hope of success in those pursuits ordinarily chosen by the college graduates, following others for which they were fitted by nature rather than by training, but in which competition would be with a weaker class; while those who had made a moderate success of college work continued in a losing competition with their classmates. If this be valid hypothesis it would account for the relative success of the lowest tenth of the class.

Supplementary still to this minor study of the two colleges, I have figures for one—the larger of the two—showing the success, according to our criterion, of the men who have received first, second, third and fourth places at graduation; that is, not simply of high grade, but those who have most nearly fulfilled the ideals of their alma mater. Of the living alumni of this institution 2.3 per cent. were mentioned in 'Who's Who' and the law of probability would lead us to expect that the percentage would hold good for the men of any given place in the class. We find that eight men of the first place were mentioned; nine of second place, and six each of third and fourth places. Since, however, the class of 1832 was the oldest contributing to 'Who's Who' for 1900, we are safe in assuming that not more than seventy men of each of these places can possibly be alive and this assumption is based upon

the supposition that not one has died in all these years. Even upon this generous supposition we find that of the *possibly* living first-place men, 11.4 per cent. have gained that renown which we have taken as an indication of high grade in life: 12.8 per cent. of those of second college place and 8.6 per cent. for the next two places of honor. If, however, we apply the figures for the mortality tables of life insurance to the honor men of the last seventy college classes, we find that in all probability but forty-one of them have survived the three-score and ten years of baccalaureate life, and that our percentages are 19, 22 and 15 respectively. These, when compared with the 2.3 per cent. which represents the success of the alumni of the institution as a whole, should, it seems to me, go some way toward refuting the widely accepted belief that the college salutatorian and valedictorian are doomed to obliquity.

The statistical evidences that the high-grade college man maintains his status in after life, which are here presented, though open to all the criticisms of the statistical method, are nevertheless in accord with our general belief of what should be. If the college course is a true preparation for life, it is but natural to expect that he who best fulfils the requirements of the former is best fitted for the latter. Were this not so, we must pronounce the preparation a failure. But the educational career is more than a mere preparation for life; it is a sample of it, cut in such a way as to show as much as possible of the figure. The elementary school course, cut small as it is, can give but little of the design of the whole piece, yet it does suggest at least its general color tone. In the secondary school one may hope to discover some few of the tracings, to gain some general idea of the figure as a whole. But in the college course, taking one as it does to the period of manhood, we may expect a sample of sufficient breadth to disclose the bolder shades and the more general designs of the whole pattern. If it does not, the trouble is with the cutting, and we should cut it differently. Seemingly the work with the educational scissors is well done, and it is a matter of no surprise that the man who matches the sample best cut matches the whole piece.

THE SOURCE OF NITROGEN IN FOREST SOIL.

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NORMAL development and growth of forest plants is possible only when the plants are able to obtain a sufficient amount of nutritive substances from their medium.

Among the substances indispensable for the nutrition of plants nitrogen occupies a conspicuous place. On an average, sixteen per cent. of this element is included in the composition of albuminous matter. Nitrogen is necessary for the formation of protoplasm of vegetative cells, and when it is absent no formation of protoplasm can take place; hence, no development of organic life in general is possible. Plants derive nitrogen from the soil, where it is found in a free state (air), or combined in the form of nitrogenous compounds.

If plants had the capacity of absorbing atmospheric nitrogen and assimilating it like carbon, the question as to the presence of nitrogen in the soil would have no interest, since the air would be a sufficient source of nitrogen. While some plants have the capacity of absorbing atmospheric nitrogen, the majority draw their supply from the salts of nitrogen found in the soil.

The consumption of atmospheric nitrogen has been fully determined for the wild acacia (black locust) and for the white and black alders. Thus in quartz sand completely free from nitrogen, seeds of black locust, while developing into seedlings, increased their contents of nitrogen from 0.0024 gr. to 0.092 gr., or more than 38 times, between May 1 and September 10. The locust in this respect resembles all the other leguminosæ, which have long been known to agriculturists as accumulators of nitrogen. On examining plants which absorb the free nitrogen contained in the soil, it was found that the roots of these plants have tubercles inhabited by organisms. These organisms are bacteria, which, attracted by the excretions of the roots, immigrate from the soil and cause the formation of root-tubercles which are invariably present in the papilionaceæ. The bacteria absorb the atmospheric nitrogen and transmit it to the plant. A great many bacteria cause tubercles on the roots; they can be classified according to the species which they choose as their host, more conveniently than by their external appearance. Each species of the leguminosæ seems to possess its own race of bacteria, which can be made serviceable to

other species only by gradual adaptation. Leguminosæ which lack proper bacteria are backward in development.

If, for instance, black locusts are grown in soil which contains no bacteria or only bacteria taken from the tubercles of leguminosæ somewhat less closely allied to them, they thrive only moderately; whereas under the influence of the locust bacteria they develop luxuriantly. The organism living in the root tubercles of the alder is also, according to Hiltner, instrumental in the absorption of nitrogen. It displays its activity particularly whenever the available nitrogen of the soil begins to be exhausted on account of its vigorous consumption by the tree. The fungi which cover the suction rootlets of oaks, beeches, birches, and other cupuliferæ, as well as conifers and many other woody plants, probably also assist the trees in the taking up of nitrogen. They do not, however, absorb the atmospheric nitrogen, but only decompose, among other organic substances, the nitrogenous compounds of humus, and thus convert them into chemical combinations more accessible to the tree.

Thus, excepting the leguminosæ and a few species of other families, plants depend for their supply of nitrogen upon the nitrogenous compounds in the soil. And it is with these plants that the question as to the source of nitrogen in the soil becomes important, inasmuch as there are no minerals containing nitrogen so widely distributed as to satisfy the demand of trees for this element. Atmospheric precipitations and the product of the decay of animal and vegetable refuse are usually supposed to be the sources of nitrogenous compounds in the soil. The chemical compounds in which nitrogen occurs in the soil are chiefly nitrates, ammonia, and organic nitrogenous compounds resulting from the decomposition of organic substances. The best sources of nitrogen for green vegetation are generally supposed to be the nitrates; but for forest trees, at least, these seem to be of small account, because, as Ebermayer says, in forest and marshy soils nitrates are present, if at all, only in small traces. Also, in the interior of stems nitrogen is found in the form of nitric acid only when they are grown on a soil containing nitrates; for instance, on cultivated land. Among the compounds of nitrogen which are supplied to the soil through atmospheric precipitation, some nitric acid is found, but two to five times as much ammonia is present. The whole amount of nitrogen which is held in combination and supplied to the soil in this manner through snow and rain amounts, according to Ramann, to nine pounds per year per acre, and even less. This is insufficient to supply the demands of trees for nitrogen, as they store up a much greater quantity. Ebermayer states the average amount of nitrogen taken up by various kinds of trees per year and acre as follows:

Beech forest,	about	44	lbs.	of	nitrogen;
Silver fir forest,	"	35	"	"	"
Spruce forest,	"	33	"	"	"
Scotch pine forest,	"	30	"	"	"

Thus, only the ammonium salts and the organic compounds of nitrogen formed in the process of decay are available for the roots as sources of nitrogen. The amount of nitrogen supplied to the soil through atmospheric precipitation, either in the form of nitrates or ammonia, is not sufficient to supply the needs of trees for nitrogen.

There remains still another source, and this is the organic compounds of nitrogen formed in the process of decay of litter. In fact, Ebermayer has recorded strongly developed roots of spruces and firs on the Bavarian Alps that grew in pure humus one meter thick, from which he concludes that the dark forest humus furnishes all the nitrogen and other mineral nourishment required by trees.

If, therefore, the source of nitrogen in forest soil is nitrogenous compounds resulting from the decay of the litter, one would expect in a forest which is managed on a business basis (that is, in which trees are removed when ripe), a gradual decrease of the contents of nitrogen in the soil, as occurs on a larger scale in agriculture. In agriculture, where the annual harvesting of crops deprives the soil of almost all the nitrogen which is assimilated by the plants, and returns to the soil only a small part of it by the decay of the roots of the plants, and where the easily soluble nitrates are washed out by rains and carried away from the fields, or deposited in layers inaccessible to the roots, the exhaustion of nitrogen in the soil sets in soon, and the artificial introduction of nitrogen becomes a necessity.

One of the most common ways of replenishing the nitrogen taken up by crops is manuring and the growing of leguminous plants which have the capacity of absorbing atmospheric nitrogen. These plants are plowed under during the period of blooming, and when they decompose they give their nitrogen to the soil. In the forest, it is true, a considerable part of the nitrogen is returned to the soil in the form of shed leaves, and only part of it, which is contained in the trunk of the tree, is removed. The washing out of nitrates from forest soil does not occur, because no nitrates are formed in it, and those which are brought in by atmospheric precipitation are decomposed under the influence of a special microorganism known as *Bacillus dentrificans,* which is formed in soils with acid reaction.

But forest soil, though it loses less nitrogen than does arable land, nevertheless loses it; and more remarkable yet, forest soils not only do not become poorer in nitrogen, but, on the contrary,

become enriched with it, a fact readily demonstrated in poor soils planted to forests.

How this loss is compensated by nature was not known until recently. The introduction of nitrogen into forest soils artificially is not practicable, and therefore the enrichment of the soil with nitrogen must go on under the influence of other causes. A certain number of leguminous plants grow in forests, but these are by no means sufficient to compensate for the loss of nitrogen through the felling and removal of forest trees. In some arborescent species, as *Alnus glutinosa, Robinia pseudacacia,* and others, tubercles which stimulate assimilation of free nitrogen are found on the roots. It may happen that such species do not occur in the forest, or that the necessary bacteria do not develop in the soil, when the loss of nitrogen would not be replenished at all. This replenishing, however, always occurs, and some sources must be found to account for it.

Recently, E. Henry, professor in the forest academy at Nancy, France, discovered a new source of enrichment of the soil with nitrogen, which is of great interest to foresters. Professor Henry has proved by experiments that the loss of nitrogen in forest soil is constantly repaired by means of absorption of atmospheric nitrogen by fresh forest litter.

In November, 1894, Professor Henry collected leaves only recently dead and still hanging on oaks and hornbeams (*Carpinus betulus*). The amount of nitrogen in these leaves was determined in per cent. of the dry substance. In this way it was found that the leaves of oaks contained 1.108 per cent. of nitrogen, and the leaves of the hornbeams 0.747 per cent. The oak leaves were placed in two zinc boxes. The bottom of one of the boxes was covered with limestone, that of the other with sandstone not containing lime. Both boxes were covered with a netting of galvanized wire. The leaves were dried in the laboratory, and 48.16 grams of their dry substance were placed in the first box, and 53.54 grams in the second. The leaves of the hornbeams were distributed in the same way. All four boxes were exposed to air, with necessary precautions against enriching the leaves with nitrogenous compounds. In December, 1895, the following year, Professor Henry determined the contents of nitrogen in the leaves taken from two boxes, whereby it was found that the oak leaves taken from the box with the limestone bottom contained 1.923 per cent. of nitrogen, and the leaves of hornbeam taken from the box with the sand bottom, 2.246 per cent. After making the necessary allowance for loss in weight of oak and hornbeam leaves owing to decomposition, Professor Henry computed the increase of nitrogen in the oak leaves at 4 per cent., in the hornbeams at .78

per cent. Thus it was proved by him that fresh leaves fallen from trees absorb atmospheric nitrogen in the process of decomposition.

The two other boxes remained exposed to the air for another year, and in May, 1896, fifty grams of fine forest soil were added to each box. On subjecting the leaves contained in them to a chemical analysis, Professor Henry found almost the same contents of nitrogen that had been found in the leaves of the first two boxes which were exposed to the air during only one year. From these results he concluded that the capacity of fallen leaves to absorb nitrogen from the air is retained only in leaves freshly fallen on old litter.

The capacity of forest litter to absorb nitrogen develops probably under the influence of special microorganisms, active only at the beginning of the process of decomposition of fallen leaves; later, however, when the process of decomposition of leaves goes on under the influence of exclusively inorganic agents, no increase of nitrogen is observed; on the contrary, a loss is shown.

It is thus scientifically proved that forest litter is capable of enriching the soil with nitrogen, but only under the condition that the decomposition of freshly fallen leaves goes on. As to the assumption that bacteria are developed in freshly fallen leaves, which, like *Rhizobium leguminosarum* Frk., possess the capacity of absorbing atmospheric nitrogen, it can only be said that as yet no bacteria have been found in forest litter.

A practical deduction from Professor Henry's scientific investigation is the advisability of planting cut-over areas as soon as possible, so that the young seedlings may find in the soil a quantity of nitrogen sufficient for their nourishment. The longer cut over areas remain unplanted, the less is success to be expected from planting, as the young trees develop poorly because of insufficient nourishment.

Thus, the forest not only furnishes timber and other products, prevents snow- and land-slides, and regulates the flow of rivers, but enriches the soil with nitrogen, one of the most essential nutritive elements of plants, and in this way transforms poor soils, fit only for tree growth, into rich agricultural lands.

EDUCATION FOR PROFESSIONS.*

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THE preparation of the man who has chosen to enter a profession involves, properly, suitability for the profession chosen, in character, ability and a special talent, if not a genius, as a basis and an excuse for that preparation. It should include a general education sufficient to give the individual the knowledge and culture demanded, in this generation, of all who aspire to enroll themselves in the ranks of the leaders of the professions, broad enough and deep enough to command respect and to justify confidence both in the man's attainments and in their utilization. It must involve training, both gymnastic and 'practical,' and development of that strength and maturity without which the professional apprenticeship of the special school can not be appreciated or its best results attained. Education, in the commonly accepted meaning of the term, should be carried as far and as high as the time, the means and the ability of the man permit and continued, if possible, until he has acquired maturity, earnestness, intelligent ambition and thorough assurance that he has chosen the right field of work for his life's long endeavors. Yet, from the day when it becomes certain that his field of work may be safely selected, a thread of special preparation may run through all the sequence of his studies without injury to their value in the development of the man.

Mathematics may be taught by examples selected from the practical problems of the coming days of professional work; modern languages may be given large place in the curriculum; the sciences may be studied in a serious manner and intensively; these latter studies may be made to conspire for his advantage in the reading of scientific matter in foreign literatures. In many and very various ways, the bent of the child, the youth, the man, may be favored without loss of culture and with the great advantage of stimulating and maintaining his interest throughout. But, in the earlier stage, it would be a mistake to sacrifice culture and gymnastic training, true education, to professional training. Quite enough can usually be accomplished in the manner just indicated without observable distortion of the general education which every youth should rightfully claim. As secondary education and collegiate work in the 'liberal' arts are to-day conducted, it is probably always possible to secure a large part of the needed sci-

* Read before the N. Y. State Science Teachers' Association, Syracuse meeting, December 30, 1902.

entific and linguistic preparation for professional study before entrance into the professional school and, as in law, for example, it is seldom wise to attempt to incorporate such work in the curriculum of the school.

It is becoming more and more common to exact of the candidate for admission into professional study the preparatory work which brings with it the diploma of a reputable college giving a liberal A.B. course. In the professional school, it is sometimes sought to arrange a system of electives for the A.B. course in the university or the college, such as will best combine its work with the requirements of the professional school, and will thus permit the accomplishment of the two lines of work in a reduced period, as, for example, at Cornell, in the Colleges of Arts and Sciences and of Engineering, in six years.

It is progress such as this which justifies the comment of Wendell Phillips regarding the value of modern education and that of Andrew Carnegie respecting the changes which have justified the words of that great orator, in our day as never before:

'Education,' says the orator, 'is the only interest worthy the deep, controlling anxiety of thoughtful men.' Says the business man and philanthropist: "The changes and the advances made in education, in deference to modern ideas, have almost transformed our universities. These now give degrees for scientific instruction upon the same footing as for classics. . . . No university could stand to-day which had not changed its methods and realized, at last, that its duty was to make our young men fit to be American citizens and not to waste their time trying to make poor imitations of Greeks and Romans."

Now, as never before, education is coming to represent the ideal of John Milton, so often quoted and so rarely disputed, an ideal that can not be too often or too impressively placed before the youth of our own day: "I call a complete and generous education that which fits a man to perform, justly, skilfully, and magnanimously, all the offices, both public and private, of peace and war." This ideal was embodied in the plan of Cowley for a 'Philosophic College' more perfectly than in the curriculum of any modern institution until, in fact, that aspiration began to find expression in the liberalized and enriched elective system inaugurated by President Wayland, and until, in the last generation, Ezra Cornell proclaimed his aspiration to 'found an institution in which any man can find instruction in any study.' This modern, and now almost universally accepted, Miltonian curriculum is based upon principles well-stated by Forel:

Education should promote comprehension and combination, but discharge the vast work of memorizing as much as possible upon books, which should be merely consulted, not learned. Make haste to forget useless trash. It obstructs your own thoughts, paralyzes your artistic sense, and dries up your emotions. Read only the choice books from among the thousands with which we are flooded.

Man must seek to improve his brain 'by a sane, voluntary and rational selection, rather negative than positive, by instructing both sexes, and by urging

the most highly organized brains and bodies to reproduce themselves as much as possible, while forcing the inferior and incompetent ones to the opposite direction.' This reform secures evolutional perfectibility, while the educational reform meets the conditions of superadded perfectibility; and only thus can the greatest of human problems be solved.*

The same idea is expressed in somewhat different words, and as viewed by Huxley's different type of mind, from a different standpoint, thus:

That man, I think, has had a liberal education who has been so trained in youth that his body is the ready servant of his will and does with ease and pleasure all the work that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic-engine, with all its parts of equal strength and in smooth working order, ready, like the steam-engine, to be turned to any kind of work and spin the gossamers, as well as forge the anchors, of the mind; whose mind is stored with knowledge of the great and fundamental truths of nature and of the laws of her operations; who, no stunted ascetic, is full of life and fire but whose passions are trained to come to heel by a vigorous will; the servant of a tender conscience who has learned to love all beauty, whether of nature or of art, to hate all vileness, and to respect others as himself.†

The right sort of a liberal education obviously begins in childhood with the growth of the observational faculties, continues through youth with the development of the power of comprehension and reflection, is finally terminated, so far as formal education goes, with those studies which are the expression of the thoughts or of the discoveries or of the deductions of great minds and which demand the employment of mature, acute, powerful and trained talent.

This is the university period, and if this can be prefaced to the professional training the man is indeed fortunate. It is the modern incorporation of the Miltonian ideal into our educational work that makes it possible for one of our ablest business men to say:

It used to be assumed that education was a hindrance to 'success in life.' The great merchant was to begin by sweeping out the store. The weakling was the proper candidate for college, whence a living might be assured him in the church or other 'learned profession.' A college education was thought a handicap against 'practical' achievement. This superstition is one of the husks the world has thrown off.‡

In an ideal university, as I conceive it, says Huxley, almost in the words of Cornell, a man should be able to obtain instruction in all forms of knowledge and discipline in the use of all the methods by which knowledge is obtained. In such a university, the force of living example should fire the student with a noble ambition to emulate the learning of learned men and to follow in the footsteps of the explorers of new fields of knowledge. And the very air he breathes should be charged with that enthusiasm for truth, that fanaticism of veracity, which is a greater possession than much learning, a nobler gift than the power of increasing knowledge; by so much greater and nobler than these

* August Forel, University of Zurich.—'Current Encyclopedia,' November, 1901.

† Huxley, Vol. II., p. 320.

‡ 'Of Business,' R. R. Bowker, 1901.

as the moral nature of man is greater than the intellectual; for veracity is the heart of morality.*

This declaration should be accepted as the fundamental principle, and the very inner spirit, of true education in all departments and as being as truly characteristic of the right form of culture as of the correct method of seeking professional knowledge. It is a characteristic of every correct form of study or of aspiration.

The 'ladder' which, in our country, leads 'from the gutter to the university' for every man who, possessing brain and physical vigor. wills it, includes the successive rounds of the public-school system. The purpose of that organization is to fit, as well as may be, 'all sorts and conditions' of youth for the life of the average citizen of our republic. It properly includes in its curriculum only those subjects which are of most value to the average citizen and it can not, and should not be expected to, provide either those luxuries of education rightfully desired by the well-to-do, or the special forms of training demanded by those proposing to enter on special lines of work, as into either of the professions. If it offers manual training, it is because that is found, on the whole, advantageous to all citizens, and sufficiently so to justify its insertion into an already crowded curriculum. Should, here and there, as in Europe, often, a trade-school be established, it should be justified by the general demand, among the people of the vicinity, for such a training; being a requirement of the place as a seat of the special manufacture, or, as with the common trades, by its systematic teaching of principles and methods that meet the needs of all and which can not be as readily, perfectly, completely and economically taught by other systems.

That 'ladder' includes our secondary schools, in which a selected body of youth are collected who have been found, by a sort of evolutionary selection, to be exceptionally well fitted to receive that higher sort of instruction. Here it is often possible for a determination of the choice of vocation intelligently and safely to be made. The pole-star may be discovered and the course may be laid directly for the desired haven. But this course must be steered, as best possible, through available and safe channels and the youth seeking ultimately to enter a great profession may be compelled—often indeed, greatly to his advantage—to follow the courses set for him by the school which is intended to promote the education of other sorts of minds. It is commonly the fact, however, that the studies here offered include those fundamentals of professional preliminary work which should always be acquired previous to entrance upon purely professional study and hence time is not wasted in securing this, which is also, fortunately, always desirable culture.

* Huxley, 'Coll. Essays,' III., 189.

The preparation of the aspirant for entrance into a profession involves the provision of a fundamental knowledge of means of acquirement of professional knowledge and this means acquaintance with the languages in which the literatures of the profession are to be found. In the case of the law school, this means Latin; with the theologist it includes Greek and Hebrew; with the medical man, it means mainly Latin, as with the others, so far as affecting early history; while, with all, this means the necessary acquirement of the modern languages, French or German, or more commonly both, and sometimes Italian and others. In engineering, it involves the acquisition of the modern languages, the sciences of the physicist and the chemist, of the mathematician, sometimes of the geologist and of the mineralogist; and it supplements these with special studies furnishing the peculiar, 'expert,' knowledge constituting preparation for the characteristic branches of the professional course.

When the whole course of preparatory work is surveyed, from primary to secondary and special, and when its relation to the strictly professional course is noted, it will be found that the latter involves so much of the admittedly educational, as distinguished from the professional, work that it thus becomes practicable for the aspirant to give all the years which his individual means and his time may allow, and most profitably, to liberally educating his faculties and to the storing of his mind with useful knowledge.

Says Dr. W. T. Harris, the philosophic educator and psychologist:*

Specialization in science leads to the division of aggregates of knowledge into narrow fields for closer observation. This is all right. But, in the course of study in the common school, it is proper and necessary that the human interest should always be kept somewhat in advance of the physical.

This is simply a statement of the fact, admitted by all, that professional training in the special school is the application, in a restricted field, of principles which should be applied in every field and in all studies, whether those characteristic of a profession or those which constitute divisions of a broad, liberal and cultural education. But it is also true that, before specialization can be properly commenced, the scholar must have terminated that division of his education which is intended to give him general preparation for 'the future of his life.' It is true that a certain amount of specialization may be practicable in the preparatory years; but it is none the less true that, in preparation for the latest stage, the student must give main attention to the educational side and leave the professional to be given main attention in years following those of growth and of development of character and of intellectual power.

The guiding hands of parent and teacher may do much in the

* *The Forum*, January, 1901.

adjustment and regulation of the educational life and progress of the young in securing that correct perspective and that direct course from haven to haven which, only, can give the highest possible result in training, in education, and, finally, in professional life. The best disposition of time, the best choice of subjects of study, the best adjustment of hours and the most satisfactory appropriation of time to work, to play, to gymnastics, and to practically fruitful exercises of mind and body, can only be determined by wise and experienced advisers.

Referring to industrial and professional training, Dr. Lyman Abbott says:

> Industrial education, in the broad sense of the term, is a function of the state; not because it is the duty of the state to give to every, or to any, man a training in his profession, but because it is the function of the state to prepare man for self-support. One difficulty with our system of education thus far seems to me to be that we have paid too much attention to the higher education and too little to the broader education. We need to broaden it at the base even if we have to trim a little at the top.*

The importance of the provision of every citizen, of either sex, with systematic and scientific preparation for the duties of life is thus a most essential provision for the future of the State. Even were we not compelled, in providing for the individual, to make provision for systematic education and training in subjects that relate to the useful arts and the duties of every-day life, it would be none the less imperative, as being vital in the maintenance of the highest interests of the people as a whole. We can not escape this duty, either individually or as a nation, and it is supremely important that we go about our work in a systematic and intelligent manner.

Regarding methods: It is interesting to observe how completely educational processes have changed, in the last generation, in every department and in every division. The old methods, which reminded one of the stuffing of the Strasbourg goose, have largely disappeared and, while it must be admitted that work under high pressure is now too generally the rule, it may be claimed that a very great gain has been effected in finding reasonable ways of teaching, and especially of importing into the study of serious, and perhaps intrinsically difficult and uninteresting, subjects methods of treatment which render the task far more attractive than formerly.

> The system of instruction by didactic methods still exists in places, but only because the machinery for carrying on the work on more rational principles has not been obtained. Wherever the object is education, the methods of research have been introduced and it is recognized that real scientific knowledge can only be gained by individual experience.†

This is as true of other subjects than those which, like physics and

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* Lyman Abbott, 'The Rights of Man,' p. 161.

† Sir John Gorst at the Glasgow meeting of British Association, 1901.

chemistry, like all the naturalist's subjects, the observational and experimental, seem necessarily to carry with them the paraphernalia of the laboratory. In every department of study there is some method apposite to that line of work which permits an appeal to the sense of inquisitiveness—a fundamental element of human nature and a most admirable and desirable one—and gives thus a means of approaching the mind by a direct and pleasant path. This is a principle now coming to be accepted as axiomatic, in education, in all its branches, and the once 'dry-as-dust' subjects are taking on new life and assuming lovely and engaging forms.

Thus we may steadily keep in mind, through the whole career of the youth intended to ultimately take part in the constructive work of the world, the fact that he must after a time take up technical studies and that, the more the work of the later years can be facilitated in the earlier, the better and the more profitable the earlier as well as the later work. The courses of instruction may perfectly well be made to include work in literature and in the pure sciences which is both valuable in the early gymnastic branches of education and useful in the later professional work. The earlier courses, in the case of the pupil, for example, who is proposing to fit himself for entrance into engineering or architecture, may perfectly well, and wisely should, be made to include just as much pure mathematics as can be had, just as much of chemistry and physics as the schools can provide and the modern languages in liberal amount.

Assuming that the aspirant for admission to the professional school, in this department, may follow his own bent, and that he desires to be educated and cultured as well as professionally expert, he will continue his work into the higher education, and there will elect advanced mathematics, will secure opportunities for experimental work in the physical laboratory, for work in analysis and synthesis in the chemical laboratory and for the study of the technical, as well as of the literary, works of modern writers in French and German and possibly in Italian and Spanish. If he is preparing himself to take up ultimately law or medicine or theology, he will similarly find in the college and university curricula various branches of study which will be of service either in shortening or in supplementing his work in the professional school. All such opportunities being taken advantage of, it will be found that the total time required to secure first an education and then a professional training will be greatly abridged without sensible loss in final results.

There are often subjects obtainable in the educational curriculum, or at least obtainable in connection therewith, which will be found either to constitute a part of the required work of the technical course, or to be likely to prove of special interest and advantage in connection

with it, and which may be incorporated with advantage to the former course, also. There are many subjects, outside the liberal courses as usually prescribed, which, nevertheless, will be found quite as valuable, as cultural and as educational, as are some subjects which are the usual elements of that older scheme. The wise man will look for opportunities to secure a good hold upon these, in substitution, if needs be, for more usual electives.

It will also be sometimes found that, to the earnest, competent and ambitious man, the commonly prescribed courses of instruction are by no means sufficient to provide a good day's work, each day, and that he may, with great advantage and without the slightest difficulty or sacrifice, increase the prescribed time and number of subjects by perhaps a third. He can not afford, in fact, to forego the opportunities which present themselves in such numbers and such wealth, up to the natural limit of his powers of safe and healthful exertion. He has but one such opportunity in his lifetime and only the man lacking in intelligence or in moral fiber will waste one hour of such precious time. In the large universities and the leading colleges of our time, the student is perplexed and embarrassed by the wealth of opportunity which is presented him. He will usually find that it will require very great care and deliberate thought to make a wise choice of subjects, to adjust himself to a wise limitation of time, so to adjust and schedule his work and his play as to make each day and each college-year in maximum degree profitable. This he should do, having in view the coming life, private as well as professional, and contemplating the utilization of that life most perfectly in the promotion of the highest interests of self, family, friends, country.

Thus, in summary, the ideal preparation of the aspirant, professionally, involves even a supervision of the child in its earliest efforts to obtain a knowledge of the outside world into which it has been introduced, a guidance of kindergartner and of the pupil in the elementary schools in the acquirement of those fundamental knowledges which furnish the means of acquirement of all knowledge, a discreet steering of the course of the older student in the preparatory schools and the finishing school or the college, and deliberate, earnest and careful choice of subjects of study and investigation in higher learning; all to the purpose of insuring that no hour of work shall be wasted by misappropriation to studies which have a less value for the ultimate purpose of the individual life than others equally available.

The preparation of the aspirant to professional standing and distinction, or even to the most modest success, thus involves wise counsel from older and more experienced minds, from the earliest to the latest years of this long apprenticeship.

Francis of Verulam thought thus, and such is the method which he determined within himself, and which he thought it concerned the living and posterity to know.

Being convinced, by a careful observation, that the human understanding perplexes itself, or makes not a sober and advantageous use of the real helps within its reach, whence manifold ignorance and inconveniences arise, he was determined to employ his utmost endeavors towards restoring or cultivating a just and legitimate familiarity betwixt the mind and things.

Bacon says, also:

And whilst men agree to admire and magnify the false powers of the mind, and neglect or destroy those that might be rendered true, there is no other course left but, with better assistance, to begin the work anew, and raise or rebuild the sciences, arts, and all human knowledge from a firm and solid basis.

Nor is he ignorant that he stands alone in an experiment almost too bold and astonishing to obtain credit; yet he thought it not right to desert either the cause or himself, but to boldly enter on the way and explore the only path which is pervious to the human mind. For it is wiser to engage in an undertaking that admits of some termination than to involve oneself in perpetual exertion and anxiety about what is interminable.

In the mechanic arts, the case is otherwise—these commonly advancing towards perfection in a course of daily improvement, from a rough unpolished state, sometimes prejudicial to the first inventors; whilst philosophy and the intellectual sciences are, like statues, celebrated and adored, but never advanced; nay, they sometimes appear most perfect in the original author, and afterwards degenerate. For since men have gone over in crowds to the opinion of their leader, like those silent senators of Rome, they add nothing to the extent of learning themselves, but perform the servile duty of waiting upon particular authors, and repeating their doctrines.

The end of our new logic is to find, not arguments, but arts; not what agrees with principles, but principles themselves; not probable reasons, but plans and designs of works—a different intention producing a different effect.*

Finally: The preparation of the physical man, like the preparation of the foundations of any great architectural structure, is a first and a last essential. Of little value is a noble conception or a high aspiration, the noblest work of the greatest architect or the highest attainments of the greatest human genius, without a solid and safe substructure, capable of supporting it at all times, in all weathers and in all contingencies, throughout a long and constantly satisfying life. Health, strength, vigor, ambition and high spirits are essential strata in this foundation of every human structure of character and value. The human mind, the human intellect, the spiritual and the moral man, can only survive and properly flourish within a wholesome and vigorous body. So closely are the mind and body related that the failure of the one carries with it, inevitably, loss of efficiency and ultimate failure of the other. Every minutest defect of body and brain of the physical man detracts from the possibilities of accomplishment of the highest and best in the profession, in the home, in the house of one's

* 'Novum Organum.'

friend. No man can do his very best as an intellectual, moral, spiritual, being without employing his physical part in its very best estate in the work. Defect of body means, always, defect in the work of the man, either in quality or in quantity.

The physical frame is a machine, a transformer of natural energies. It is at once a home for the soul and a wonderful, an intricate and mysterious prime mover, an engine of which the motive forces are as yet undetermined and unmeasured. We know that its perfection is essential to the perfection of the humanity which it encloses and of which it is the vehicle; we know that the display of the intellectual and the spiritual power, the genius, of humanity is dependent upon the provision of ample stored physical energy and of efficient means of kinetizing and applying it to the purposes of the mind as well as of the body; we know that the animal machine is not a heat-engine; we think it is not an electrical generator; we are coming to believe that it is some form of chemical motor—possibly one in which the vital, the physical, and especially the chemical and electrical, energies find common source and origin in a common point of emanation. We know that, whatever its nature as a motor, it has an inherent efficiency far superior to that of any heat-engine yet devised and constructed by man. We know that it requires certain well-ascertained elements as its fuel—or food—that it must be kept well within the requirements of certain well-established physical laws; that, to maintain and promote its best and highest work, it must be cared for with scrupulous attention to certain definite hygienic laws. We know that the best possible, the highest possible, can only be attained by man when this curious and mysterious and inseparable vehicle of the soul is thus maintained in its best estate.

The building of the body—which means the building of the brain, always, and just as absolutely—the construction of the physical side of the man, is actually a problem in architecture and engineering and one, like all such problems, capable of a good or a bad or an indifferent, but never of a perfect, solution in any actual case. The building is carried on by mysterious and unknown forces within it and we can never touch them or their work without embarrassment or injury to both. We do, however, know positively certain laws and their action and certain rules of procedure in the adjustment of exterior conditions, favorably or unfavorably, and in supplying the necessaries of wholesome life. We know, in a general way, what should be the methods of life, of diet, of exercise, of use of powers of body and of mind. We know enough to make the difference, in most cases, between health and disease, success and failure of the physical man, and, in consequence, thus largely to determine the success or the failure of the real, the intellectual and spiritual, man.

The materials of the builder and their preparation for use are, on

the whole, well known, for best construction, and it is well established that a frugal yet ample supply is essential of those substances which furnish in potential form the energy which is demanded by the animal machine. Especially should we avoid such kinds as will clog the machine and impede the evolution of the potential energies in kinetic form. These constitute main conditions of production and of maintenance of the maximum efficiency of the machine, and also of its passenger, the inner man, with whom, even in our individual selves, we have so uncertain and so mysterious an acquaintance.

Man has learned by scientific methods to identify and utilize a vast number of materials distributed amongst the various kingdoms of nature and the physician and the surgeon are able to perform wonders in the maintenance and repair of this mysterious motor. Plainness and simplicity of diet, frugality and maintained efficiency of the apparatus of preparation, are thus requisites for highest attainments, whether in physical or in intellectual and moral and spiritual realms, whether in gymnastics, in learning, or in imagination and in spiritual life. The famous athlete, the great man of science, the philosopher, the poet or the divine, each and all live a better life and are more perfect men in proportion as they perfect the physical side.

Methods of life and habits of body and mind exercise an enormous influence upon the health, happiness, capacity and achievement of the man. It is the daily experience of every one that only when the body is at its best can the mind and the soul rise to highest levels. Keep the animal machine in good order and the highest efficiency of the being dwelling within it is maintained—and only thus can efficiency be attained or maintained.

The teachings of comparative physiology, indicating what are the desirable and what the undesirable materials of construction, and the teachings of the natural instincts which, in the child as in the animal, reject harmful substances, give ample instructions to him who seeks, honestly and earnestly, for such knowledge. Guided by these precepts, an ambitious and intelligent man can usually find his way safely and successfully through the snares of this world which everywhere trap the foolish and unwary.

With ordinarily good physical health and a good body within which to dwell, at the outset, the way by which to an approximation of the ideal perfection of Agassiz, the 'soul of the sage in the body of the athlete,' is open to every man. No aspiring and earnest youth need doubt which is the proper course. The way toward the ideal, the perfect, man, is open to him.

The prerequisites of a successful life are health, strength, intelligence; power of self-control and of self-direction; selection of that profession, or that vocation, which gives largest opportunity for the pecul-

iar talents and ambitions of the aspirant; a good general education; a complete professional training; habits of work and play in due proportion; ability to keep abreast of the times, socially, professionally and generally; capability of meeting and of making mutually helpful all people with whom the accidents of life bring one in contact in social or in professional life, and a good-tempered persistence in making a record that shall, with its steadily lengthening and strengthening chain, become a constantly more and more helpful factor of all success.

Professional success attained, the greatest problem, that of making that success in highest degree valuable and productive, is one which appeals to the thoughtful man more importunately than ever could the problem of gaining a triumphant success in any division of the great world of humanity. It is not so much the acquirement of wealth, whether of money or of wisdom or of fame, which must compel thought and anxious sleeplessness, as it is the problem of investment and of securing safe and satisfactory returns on the accumulated and invested capital. If the capital consists of material wealth, the question how to use it for the highest and best purposes becomes a serious one and the example of the great philanthropist is studied to ascertain the outcome of his endeavor to do most and best with his surplus, to learn how far such attempts have hitherto proved successful and how far they have proved unfruitful or harmful. If the capital is personal fame and power and influence, the same question comes up in a modified form and the successful man is fortunate, or unfortunate, after all, proportionally as he is able to make his fame and power and influence felt for good in the great world's movements.

The ultimate measure of the man, of the woman, is the degree of final approximation to the success of a Peabody in promoting education, of a Carnegie in giving men opportunity to learn and to develop, of a Booker Washington in promoting the advance of a race, of a Roosevelt in advancing the standard of honest and patriotic politics, of a Rockefeller in discreetly seeking out the greatest needs of humanity and providing for their effective supply, of a Vassar in promoting the special care of women in their intellectual life, of any approximation gained for self and others to a higher life in wisdom and learning, in knowledge and culture.

The prerequisites of success are the perfect training of the body, brain and soul; the methods are scientific, in education, in training and in practice. The resultant form is a specific type, a species. The results of the work are as specific, in every profession; usually measured, crudely, by accumulated capital, in form of learning, of skill, of property; but its use is ever the same, its abuse usually common to all forms. Its use is the elevation and upbuilding of humanity, its abuse self-gratification; its glory is seen in the progress of mankind.

SCIENCE VERSUS ART-APPRECIATION.

BY JOHN QUINCY ADAMS,
PHILADELPHIA, PA.

A PERSON traveling for the first time in a foreign land is often puzzled by its customs and institutions. He can not understand why people lay so much stress on forms which seem to him trivial, and, with good intentions, habitually do so many things which he considers immoral and vicious. These will remain incomprehensible to him as long as he attempts to judge them by the laws and habits of his own land—the common mistake of travelers.

In like manner, an inhabitant of the realm of science, entering the domain of art, misconceives its character, because he does not understand its language, methods nor traditions. The scientist carries with him into the field of art the mental habits and standards peculiar to his native soil, and whatever can not be measured by scientific methods escapes his notice.

We know that the botanist, the housewife and the farmer see a different set of properties in the common dandelion, and would classify it respectively as compositæ, food or weed. In the same way, one sees in each object what one looks for, and this is determined by one's mental habits. It is but logical that the scientists should seek in environment the leading characteristics of science, and should expect to arrive at truth by analysis and generalization.

Scientific ideas rule not only the scientists—they dominate also our science-trained age. Evidence of this confronts us whichever way we turn.

We see nearly every field of human effort controlled by specialization. It is no less clear that the aim of the manufacturer, as of the investigator, is to set forth 'the latest thing out.' Every province of human interest has been brought under scientific classification, so that nearly all thought is now cast in 'general ideas.' This mode of thinking ignores individuality and sees in men and things only units of a class. For this reason, man is content with countless repetitions of the same form because his class idea is realized if it find in each object the few characteristics common to the group. Therefore, in general many of man's needs are satisfied with mere form, and if he sees objects possessing these formal features sitting in art's accustomed seats, he does not call in question their titles, but allows articles of furniture, forms

of ornament and styles of architecture to retain their historic names, and though their beauty has departed like the glory of some ancient family, he renders homage to their silly and meaningless descendants because of their name and position. The world has been filled with these ugly forms made in the name of art, but they only bear witness that science has subdued the earth and now holds undisputed sway.

Not only has it driven art into the background, but it has misrepresented its character.*

Science has led man to expect art to set forth phenomena, to illustrate events, to communicate knowledge with absolute exactness. It has taught us to believe a work of art worthless unless it give precise information which can be verified by an appeal to facts. But man turns to art for the fulfilment of these expectations only to be sadly disappointed. Weary and cast down, crowds leave the museums with curiosity unsatisfied, with small addition to their learning, but denouncing art for failing to keep the promises of science. As well condemn the law of gravitation for the death caused by a falling rock.

Accustomed, as we are, to the precise and unequivocal terms of science, we expect the language of art to be equally explicit, and just at this point we are led astray by supposing that the artist—like the scientist—has something definite to communicate. Like the pioneer, the artist does not know what is ahead of him, but, driven by his creative impulse, beset by all sorts of perplexities, he struggles on over unknown regions until he reaches a point which satisfies him. What he produces is the outcome of his creative power, which picks and chooses its material from nature, breaks up and recombines again, and this process is continued until an effect is produced which his esthetic judgment pronounces good. The very terms which the artist uses are vague and indefinite, each one having an infinite number of meanings, determined not by any inherent quality, but by its relation to other terms in the same work of art. For example, a straight line has little esthetic value in itself; nevertheless, it is of great importance in one picture and almost indispensable in another. In like manner, the meaning of every bit of color varies with each change in its combination with other colors; or a musical tone may be a commonplace noise in itself, but as a part of Lohengrin's Wedding March it thrills one with delight. For this reason, a dictionary of artistic language is impossible. Not a line, a form, a color nor a rhythm stands for a definite idea, the meaning of each one depending not only upon its relative position as expressed by the artist, but also as appreciated by the spectator or listener.

* The reader must keep in mind that we are not contesting the great value of science and its methods, but that we object to these methods being applied to art.

I think we all agree that for each learner, science consists essentially of definite, objective facts which must be acquired in much the same way that one gets possession of other external objects. Upon demand, the student must show the amount of stock on hand, and this is taken as the index of his success. When the teacher wants to mark progress, he requires each one to open his mental storehouse and exhibit the sum of its contents.* It naturally follows as a corollary that the chief aim of science-teaching is to stimulate the pupil to gain possession of scientific realities, and thus add to his stock of knowledge. Each fact acquired is an addition to his mental possessions. Therefore, he must dispassionately learn what actually exists, never forgetting that he is nature's witness and that his testimony is valuable only in so far as he tells the whole truth and nothing but the truth.

On the other hand, art can not be analyzed into equal units, nor its composition expressed by a formula. Neither can its character be determined by the application of rules and measurements, for each work of art is a new thing in the world, and is, in fact, a law unto itself. To attempt to measure art by these quantitative and objective standards is like taking a sieve to fetch water. Art being a degree of harmony, an expression of feeling, a way of doing, it can be estimated only by one who has sufficient capacity of feeling. There is no yard-stick which can indicate to every person the exact amount of art in any given production. The only way to estimate it is by a direct appeal to one's own internal measure, called appreciation. As Plotinus long ago said, 'The kingdom of Art is within us.' We are misled into thinking that there exists a common objective standard, because we so often find many competent judges agreeing as to the merits of a work of art. Undoubtedly, there may be a great similarity in personal standards due to a common artistic environment and a similar social heritage, which have formed our conceptions of art as of all other objects depending on personal valuation. The main object of art-teaching therefore should be to build up within each pupil the highest possible standard of esthetic appreciation. He must be incited to make esthetic judgments as to the quality of objects, and in this way he develops his capacity to appreciate. Each decision made is a distinct mental growth.

However, to meet the demands of our examination system for a definite quantity of knowledge, we teach only a body of collateral facts so closely related to art as to deceive us into thinking that it is art. We are satisfied to obtain results which can be measured by a definite,

* As the pupil finds that courses of study, systems of examinations, methods of promotions, and in fact, the phenomena of science itself, are all based on the quantitative and external standard of measurement, it is but natural that the one idea that takes possession of and dominates his intellectual life is that quantity is the sole criterion of success.

objective standard. For example, as literature, we teach analytical grammar, philology, history and events. As a regular exercise in English literature in many schools, students are required to put a beautiful passage of Shakespeare into English! Now, in reality, such a process never carries one beyond the mere incidents of a literary masterpiece, and the one element which makes it a work of art, namely, its power to infect the reader, with the emotion of the writer eludes all such analytical pursuit. Many of us after leaving college, take up Shakespeare, Lowell, Wordsworth or Hawthorne, and are astonished to find them interesting and inspiring. Our apparent purpose in teaching music is to develop dexterity, as though every child were to be a musician.

The plastic arts are taught as parts of an external body of knowledge which the pupil may take in and then give out again, as though his nervous system were glass with the power of transmitting, with more or less accuracy, forms, colors and sounds. Such strong emphasis on the acquisition of technical skill reduces the study of art almost to the level of learning a trade. Those teachers and pupils who pursue higher ideals find themselves in conflict with the accepted educational canons. These, as I said above, demand measurable results which are most easily secured in the plastic arts by devoting the time to training all the faculties to bear upon production. While the appreciation of art may be learned, incidentally, by this method, the index of progress is the amount of dexterity acquired so that all the faculties become set towards making something. This, no doubt, is an excellent way to learn a handicraft, but a questionable method of cultivating understanding and appreciation. Although it can not be denied that a thorough knowledge of how a work of art is produced, of the skill displayed in overcoming special difficulties, affords a peculiar pleasure, we must not forget that the same pleasure comes from seeing, for the first time, anything skilfully done, the difficulties of which one understands. And this is true whether it be artistic or purely mechanical. Whether it be the production of a tone on the violin or the ingenuity of a knitting or type-setting machine. Such ephemeral pleasure comes not from esthetic emotion but from scientific knowledge.

In the days when manufacturing was by handicraft and every workshop was a school of art, there was less need for teaching art in any other way. But since the factory has displaced the workshop, and the operative the handicraftsman, there is no chance in industry for the application of art, except in a few cases. Art is no longer a quality of the product of every-day work as formerly, and it is hopeless for us to expect it to be. And with its departure from industry, art has vanished from the daily life of men. This is not surprising, because, although the long and toilsome road to art by way of production is closed up by

the advent of machinery, we still insist on teaching all pupils to approach by this route. The result is that few ever emerge from the drudgery to enjoy the beauty in the world, because in school they learn only the a, b, c of drawing, painting or modeling and such meager skill is a very poor guide to the great domain of art. In fact it has restricted the attention to a very small part only of the artistic field and so narrowed our conception of art that to-day very few, even intelligent persons, think of art as a possible quality of nearly every human act as well as of its expression in the concrete. I have heard eminent professional men denounce art in language too strong to print, declaring it to be only an absurdity. I once asked one of these art-haters if he thought the room in which we were sitting would be as comfortable and pleasant if it were four times as long and one fourth as wide? I followed his emphatic 'No, of course not!' with the remark that proportion is the corner stone of decorative art.

A short time ago, in conversation with a very successful worker (an Oxford man) in one of the great social settlements of London, I was emphasizing the importance of art in social work. He interrupted me with: "Oh, yes, we don't go in for art here, but they do at Toynbee Hall. We go in for music, acting plays, literature and dancing." He seemed very much taken aback when I exclaimed; 'But I include all those under art.'

This testimony of these two typical witnesses, I have selected from a large amount of evidence which shows, that to most persons art is a small book written in a strange tongue. It seems incredible that the intelligent world should limit art to pictures and statues. Even Mr. Whistler, when he says: 'There never was an art-loving nation,' evidently has in mind only the plastic arts; for there never was a people who did not love art in some form. Ever since man began to reshape the external world; to employ his leisure to give pleasure to himself and others, art has been the one universal mode of communicating feeling. There is not, and there has never been, a group of people which has not expressed its emotions in some form of art.

As I have said above, science is largely responsible for the widespread misconceptions and indifference to art. It has dug a new channel into which it has turned the current of our thought. Out of these conditions naturally arise methods of teaching art which reinforce our wrong notions and increase our apathy; for the results approved by science are produced by pupils and teachers devoid of all appreciation for art.

In art, as in all forms of human activity, to produce and to consume are diverse operations which call into play different sets of intellectual faculties. Why, then, are not both producers and consumers legitimate claimants to recognition in education? In the nature of things, is there

any reason for granting the claims of production, only, and teaching art in all our schools as though all children were to be nothing but producers? Is it not as important to use wisely as to make well? In art, should not children be taught to appreciate, independently of the use of tools? Certainly, no one will maintain that appreciation depends upon ability to do, but on the capacity to understand. One may enjoy the beauty of a house although one lack the skill to drive a nail; great pleasure may be had from the splendors of a gothic cathedral without knowing how to build one; and even the primrose may fill one with esthetic delight.

Here, then, we have two educational ideals. While I do not wish to minimize the great value of technical training in handicrafts as a means of developing character, I wish to insist that learning to do and learning to enjoy are independent and totally different functions. Every writer on economics dwells upon the important distinctions between makers and users, and the common experience of every-day life teaches that it is possible for man to make what he detests and thoroughly enjoy what he can not do.

There is no doubt of our ability as producers, and this vast power has been obtained by sacrificing our artistic instincts on the altar of production. Our modern society, like some great oak, has put forth all its vitality to extend one mighty branch, but to do this, it has sacrificed its symmetry and beauty.

The pleasure derived from an object of art—as from any object of enjoyment—does not depend upon an external standard, for, though a work of art may be pronounced perfect by competent judges, I may derive no pleasure, whatever, from it. In order to enjoy, I must be able to join hands with the artist and partake of his feelings. Every artistic conception is surrounded by an atmosphere of pleasurable emotion, and the art consists in giving expression to this. To be infected with this feeling, the mind of the spectator, like the sensitive plate in a camera, must be prepared to receive it, that is, it must possess the requisite capacity. Let us keep clearly before us that our goal, now, is not the acquisition of facts and opinions; it is not learning esthetic rules, nor relying upon some authority; these may assist, but no amount of such collateral truths can add aught to one's standard of appreciation—this can be done only by the action of the mind itself. The power to enjoy art, like the strength of the blacksmith's arm, is developed only through use. As a meteor entering the earth's atmosphere is set on fire by friction, so the feelings are enkindled by vital contact with art. Now this does not come alone from visiting picture galleries; attending grand operas, or reading the poets. These are favorable conditions, but in order to increase the power of appreciation, one's esthetic sense must find a place to rest its foot—where it may pause with delight.

This implies the perception of art. In this we have the process of growth, for the standard of appreciation is built up out of a countless number of these esthetic judgments—judgments rendered by the joint action of the emotion and the intellect. Hence the art-teacher is typified by the horticulturist who trims, buds and nourishes, making all conditions as favorable as possible, but recognizing that here his power ends, and that all growth must come from within. As all plant culture requires essentially the same methods, so the cultivation of appreciation rests on a few identical principles, no matter what branch of art is studied. Beneath the apparent diversity, art is a unity.—When the pupils of Angelo asked: 'Master, which is the greatest art?' he replied: 'I know of but one art.' So that our art instruction must rest on the great fact that art is not something done in a corner, but is as broad as human life. Not a nook nor cranny of human activity which does not hold some gem of joyous workmanship. Art shuns no medium, but clothes alike the Parthenon and the humblest object of daily use with dignity and beauty. As it forms some part of the environment of every child we naturally begin to build its standard of appreciation with the material nearest to hand. In literature, we do not begin with Wordsworth and Emerson, nor in music with the Ninth Symphony; why should we begin the study of plastic art with its most exalted forms? Life's interest centers in its immediate environment, and as it is with this that all rational education begins, we commence our instruction by teaching children to appreciate the art in the common and familiar objects which they touch and handle every day. In spite of the most rigid demands of utility, a big percentage of man's toil is devoted to the ornamentation of practical objects. The concrete world takes on every whimsical shape or color that can be thought of to solicit favor, and we pick out objects chiefly for the attributes which please the eye. Few will deny that very much of this is in bad taste and does not satisfy the esthetic sense, but gratifies some merely transitory feeling. Notwithstanding, we surround ourselves with these tawdry objects, because in the bewildering flood of forms and colors in which human effort takes shape we must direct our course by the chart with which we are most familiar, and this as the world goes is a price-list. Trusting too much to this, and urged on by fickle motives, it is not strange that in our search for art we lose all bearings, like the sailors perishing from thirst who hailed a distant ship for a little fresh water: 'Dip down! You're in the Amazon!' was signaled back.

Though few are aware of it, in every neighborhood are some works of art in daily use, and more hidden away in garrets, such as articles of table service, embroideries, household furniture, toys, kitchen utensils and workmen's tools. Nearly every kind of article has at times been made by artists. What a surprise to most young people to find out that

art is not something afar off; to discover, as well, that every object made by man is full of meaning, having not only a character of its own, but being also an epitome of its maker's biography and a page of the history of his time. In fact it is a truer record of human action than printed page or spoken word.

With such a wide range of objects, the choice must be left to the teacher who can guide only where his love and appreciation light the way. As any object will do for a sign-post to beginners in this field, let us take a good specimen of a Chippendale chair which we place before the pupils. We call attention to its simplicity; lead the pupils to see the sincerity shown in its workmanship; to feel the dainty touches of originality in working out a pattern; help them to see the sufficiency of clean wood, free from ostentatious ornament, sham graining, and specious varnish; point out that the carving does not vaunt itself but artlessly adds to the charm of the whole; aid them to find out that no small curve could have been left off without loss of beauty; lead them up to appreciate its symmetry and unity—the highest notes in a work of art.

To place beside this a costly and gaudy chair, and to contrast it point for point with the Chippendale, will clarify many hazy esthetic perceptions. A mere hint will persuade most pupils of the futile attempt to make an ugly object beautiful by excessive ornamentation; that the chief end of varnish seems to be to fill cracks and cover up faulty workmanship; and that a chair filled with twistings and turnings is not unlike the fool who thinks he will be heard for his much speaking.

Let the young people but look at and think of the two chairs, and the simple dignity of the one will soon bring to view the braying vulgarity of the other. Their character will come out strongly if the pupils are prompted to strip off, in thought, as much as they can from each chair, without marring its beauty or taking from its utility. The Chippendale will bear the loss of very little, if any; whereas the other can give up a large heap of rings, warts, grooves, paint and contortions without taking from its usefulness, but, on the contrary, adding much to its beauty. Now as a better chair rises out of this rubbish, an economic truth will come into view: that a large amount of labor is spent to produce ugliness—to debase raw material. As one by one the artistic objects of common life are examined in this way and approved by this quickened power of appreciation, the non-artistic, also, will be forced to stand before the bar of the esthetic judgment to give an account of their purpose in the household. In most houses, the great number that will have to plead 'guilty' to the charge of worthless, defective or faulty must lead to an inquiry as to the function and relation of articles in the home, and an added zest will be given to this study of decoration by the discovery that the choice and arrangement

of furniture are fingerposts to character. We see, in turn, the homes of the loquacious, the conventional, the shallow, the vain, the sincere, the refined, the deceitful, the vulgar; in fact most human virtues and weaknesses are unconsciously stamped on man's chosen surroundings. Such a study of decorative art will fit the student to take up, in the same way, other branches of art, and finally painting and sculpture.

Although now recognized by a few people that these two subjects may be intelligently studied without learning to paint or model, their true educational value is lost through the manner of teaching them. Either they are taught as purely sentimental subjects with which rude facts have nothing to do—as though they possessed some mysterious essence of beauty too ethereal to touch or think on; or else, like chemical substances, they are analyzed into their elements, the relation of their parts determined mathematically and the mannerisms of the artists pointed out and carefully noted down. Now while certain attributes of a painting and the balance of its parts are curious, and, for certain purposes, important items of knowledge, to single them out and teach them for their own sake, supposing it to be the study of art, is not unlike the mistake of the foolish virgins. The few features of a painting made use of to build up appreciation must be judiciously selected as witnesses to testify to the character of the art and thus assist the student to arrive at a just esthetic decision. The choice of facts for teaching art is determined by the capacity of the learners and like the pawns on a chess board, their value lies in the way they are used. Every choice that man makes illustrates the truth that all appreciation roots in experience; it therefore follows that a work of art is a sealed book to the spectator unless it deals with phenomena which are related to his mental world. For this reason, it is unwise to place before pupils paintings and statues which lead them into a foreign world of ideas and customs. The subject-matter should be explainable by the pupil's experience, leaving the art as the only new thing. As the character of pictures should be determined by the age and understanding of the pupils, rather than by the glory of the work of art, it naturally follows that for young people it is wise to select those works which portray familiar features of their known world. Our cities contain first-rate collections of modern art which can be thoroughly studied instead of making use of photographs of old masters, so foreign to the pupils. This will not seem so difficult if once recognized that a museum is not a storehouse, but a laboratory.

All art instruction, however good it may be, is bound to remain incomplete unless the school-room, its background, is brought into harmony with it. This can not be done by merely hanging the walls with pictures, as is clearly shown by the attempts in two of our large cities. The class-rooms in at least one public school in each of these

cities have been 'decorated' with large and beautiful photographs of famous works of art. But the want of harmony in the proportions of the rooms, the ugly color of the walls and woodwork, the hopelessly commonplace paneling, and the inartistic seats, make the pictures as much out of place as mailed knights in a modern regiment. While such incongruity may make the vulgar stare, it can not but make the judicious grieve.

During recent years the cause of art has been espoused by professional esthetes with whom art is merely a fad. They use it as a means of self-advertisement. Such persons have no feeling for art and are blind leaders of the blind with the well-known result. As Mr. Whistler says in 'Ten O'clock': 'The voice of the æsthete is heard in the land and catastrophe is upon us.' For only he can teach, in whom the spirit of the artist dwells.

Considered and taught from the standpoint of appreciation, art becomes a vital force in the lives of men and forms an important factor of their effective environment. Each person, gratified at his growing powers of appreciating art at first-hand, is led to re-survey the surrounding world with this new artistic standard. This quality of expressing its maker's delight, which many objects possess—and nearly all may possess—is sought for without any other stimulus than the pleasure derived from gratifying the esthetic sense. Each object is made to stand a new trial and respond to a new set of demands. All the elements of environment are scrutinized, then condemned or approved; for, contrary to the popular notion, the majority of mankind have a latent power of appreciation for art, but like the water hidden in the rocks in Cyprus, it will come forth only when struck in the right place and manner.

If a woman, with a good esthetic standard, goes forth to buy furniture, she is no longer in a mood to be persuaded to buy an object, unless it comes up to her conception of beauty. Neither gilded ugliness, expensive tawdriness, nor the 'latest thing out' is wanted, but a character which she can live with and enjoy. Such a demand on the part of a goodly portion of purchasers would materially change the character of our manufactured product and leaven our social and industrial life.

THE FOSSIL MAN OF LANSING, KANSAS.

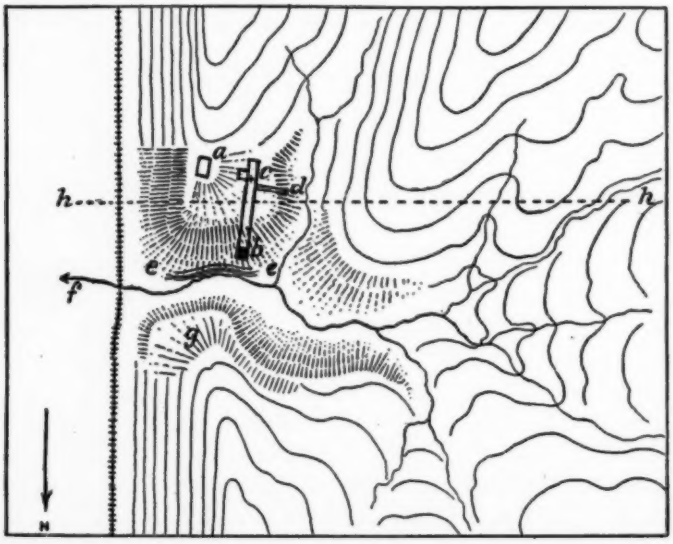
By Professor S. W. WILLISTON,
UNIVERSITY OF CHICAGO.

CLOSE by the mouth of a small but deep ravine opening into the valley of the Missouri River eighteen or nineteen miles northwest of Kansas City, and two and a half miles east of Lansing, Kansas, a farmer and his two sons, some two or three years ago, began the excavation of a cave to be used for the storage of their farm and dairy products. In the intervals of their more active farm work, this excavation was carried further into the side of the hill, until it had reached a length of nearly seventy feet. In February, 1902, a human skeleton was exhumed at the end of this cave or tunnel, but it excited no great surprise, since many fragments of bones had been found in the progress of their work. Fortunately, however, most of the bones were saved, though some were broken up and removed with the excavated material, from which not a few were recovered later. In the latter part of March, Mr. Michael Concannon, the elder son, took with him to Kansas City a fragment of one of the jaws and showed it to a reporter of one of the daily papers, by whom a brief account of the discovery was published.

This notice attracted the attention of Mr. M. C. Long, the curator of the Kansas City Museum, a gentleman who has long been interested in things archeological. Mr. Long immediately visited the place of the discovery in company with Mr. F. Butts, and secured such parts of the skeleton as had been saved. They recognized the importance of the discovery, and, from Mr. Long's description, a more extended account was widely published by the newspapers, with more or less embellishment, as that of a glacial man. On July 18, the present writer, in company with Mr. Long, made as thorough an examination of the place of the discovery and the accessible remains as was possible at the time, the results of which were briefly published in *Science* of August 1. In this paper he affirmed his belief in the post-glacial age of the remains, attributing their inhumation to a time when the Missouri River flowed at an elevation of forty to fifty feet above its present bed.

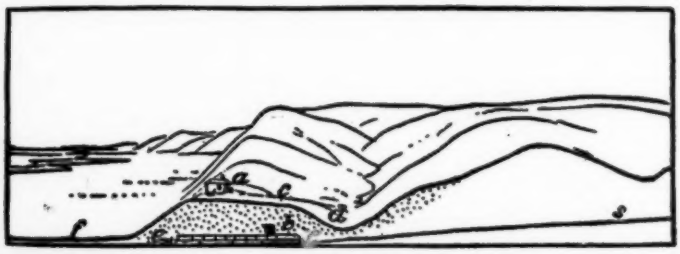
Very soon thereafter the subject received the attention of a number of eminent geologists and anthropologists, those most competent to express an opinion upon the age of the deposits in which the bones

were found and the character of the remains, who thoroughly examined the excavation and the bones. Among these were Professors Winchell and Upham, of Minnesota, Haworth, of Kansas, Chamberlin



SKETCH MAP OF THE LANSING SITE. *a*, Concannon dwelling and point of contact of limestone river bluff and recent bench. *b*, Entrance to cellar-tunnel. *c*, Inner end of tunnel where skeleton was found. *d*, Trench opened by Bureau of American Ethnology. *e–e*, Outcrop of limestone of floor of excavation. *f*, Entrance of rivulet to Missouri river flood-plain. *g*, Contact of limestone spur and bench remnant on north side. After Holmes.

and Salisbury, of Chicago, Calvin, of Iowa, and Drs. Dorsey, of Chicago, Holmes, of Washington, and Hrdlicka, of New York, all of



SECTION OF THE LANSING SITE SHOWING BLUFFS AND RIVER BEYOND, LOOKING SOUTH. *a*, Concannon dwelling and point of contact of limestone river bluff and recent bench. *b*, Entrance to cellar-tunnel. *c*, Inner end of tunnel where skeleton was found. *d*, Trench opened by Bureau of American Ethnology. *e–e*, Outcrop of limestone in rivulet bed. *f*, Entrance of rivulet to Missouri river flood-plain. *s*, Grade of steam bed. After Holmes.

whom agree upon the essential facts concerning the discovery and the genuineness of the remains themselves.

While, however, the authenticity of the find has never been questioned, save by a Kansas City newspaper, the nature of the deposits in

which the bones were found, and, in consequence thereof, the age of the bones themselves has been the subject of not a little discussion, and of wide differences of opinion. Already the literature of the subject is considerable, and the reader who chooses may find it in the discussions by Professors Winchell and Upham, in *Science* and the *American Geologist,* by Professor Chamberlin, in the *Journal of Geology,* and, more recently, by Dr. Holmes, in the *American Anthropologist.* The subject, too, has been fully discussed at the Congress of Americanists in New York, and at the various meetings in Washington during the session of the American Association for the Advancement of Science.

It is fortunate that the conditions were such that there can be no

VIEW LOOKING NORTHWARD ACROSS THE MOUTH OF THE TRIBUTARY VALLEY, showing Concannon's house at the left and the truncated slope under it, the mouth of the valley just beyond, and in the center the north bluff with its truncated face overlooking the Missouri bottoms, on the edge of which the railroad lies. The bluff is about 160 feet high. From a photograph by Mr. Chamberlin.

serious doubt concerning either the discovery itself or the nature of the remains. The small ravine, near the mouth of which the bones were discovered, opens upon the flood-plain of the Missouri River from the west. The ravine is less than a mile in length, with a fall of more than one hundred feet, and has no running stream, save perhaps for a short time in wet weather. Very near its mouth it has a tributary branch, perhaps a quarter of a mile in length, coming from the south, nearly parallel with the river bank. It is at the extremity of the intervening spur that the excavation was made, beginning a few feet above the bed of the ravine and extending southward nearly horizontally for a distance of seventy feet. The cave itself has for its floor in its whole

length, a thick, nearly horizontal stratum of carboniferous limestone, but the material excavated is believed, in most part at least, to have been deposited by either the river or the recurrent freshets in the tributary ravine. The excavation has a width of about ten feet, and a height of seven or eight, the roof being slightly arched, which, with the walls, have retained their shape without support. Upon the floor, for a thickness of one or two, or in some places perhaps more, feet, there are many broken pieces of limestone, and shales, for the most part worn and disintegrated, that were evidently the talus from the adjacent hillside of carboniferous rocks. With these, however, and sometimes at higher altitudes there are not a few larger masses of

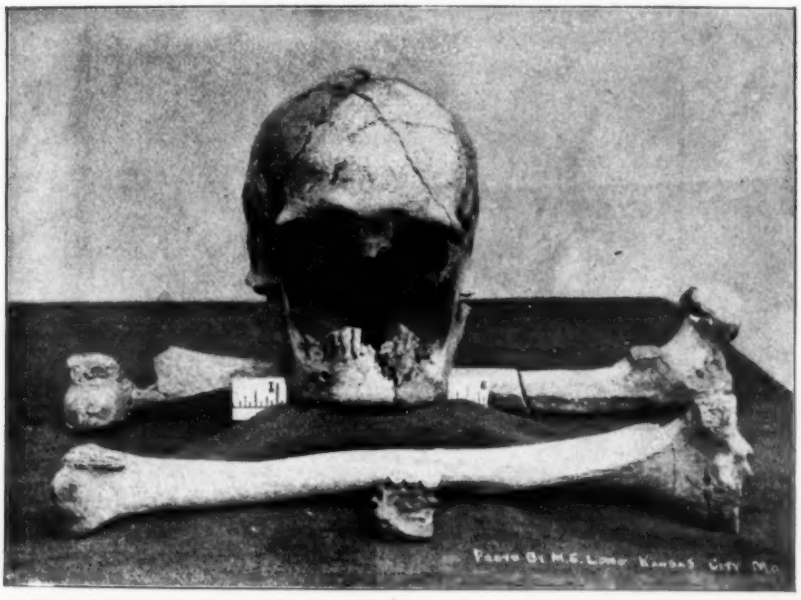
ENTRANCE TO THE EXCAVATION, LOOKING SOUTH.

sharp-angled limestone masses, lying horizontally. In this talus material a number of fragments of water shells were found. About three feet above the floor, on the west side of the tunnel, and extending nearly horizontally inward, there is a stratified layer of finer material. At places this stratum is pinched out and scarcely distinguishable, and later excavations show that it does not extend further than the end of the tunnel as first excavated.

Its material is not unlike that of the walls of the tunnel elsewhere, though less coarse. Above this stratum, evidences of water stratification are indistinct or wanting. In some places there are whitish horizontal streaks of limited extent, and some observers believe that distinct indications of stratification are shown in the disposition of the

occasional masses or small nodules of limestone and pebbles. However that may be, there are not a few fragments of worn limestone and

SIDE VIEW OF SKULL AND FEMUR FOUND IN THE TUNNEL. From a photograph by Mr. M. C. Long.



FRONT VIEW OF THE SKULL, TIBIA AND FEMUR OF ADULT SKELETON, with Maxilla of Child in foreground. From a photograph by Mr. M. C. Long.

occasional pebbles, for the most part of local origin. Otherwise the material of the walls and roof everywhere is a fine, siliceous, sharp

angled silt, firm and lumpy when dry, but a soft mud when wet. It contains some, but not much, carbonate of lime disseminated through it, and is of a yellowish brownish color. At the edge of the roof, near the outer extremity of the tunnel, the writer dug from the wall a complete cast of a river clam. The original shell had entirely dis-

LIMB BONES OF THE LANSING SKELETON.

appeared, leaving, however, the external markings sharp and clear. No other similar specimen has been discovered in the later excavations. Land shells, of three or four species, are abundant everywhere in the material. Fragments of bones of other animals than man have been discovered in the excavation, but they are indecisive in character,—a part of a bison vertebra, a mere fragment of a small artiodactyl metapodial, etc.

Additional excavations at the end of the tunnel, and a cross-section, undertaken at the instigation of Mr. Holmes, have disclosed the projecting point of carboniferous shales underlying the superincumbent drift material, between the end of the tunnel and the near-by bank of the river. Above the skeleton, the thickness of this silty material is

about twenty feet, and the elevation of the terrace or knoll, between the tunnel and river bank, is about ten feet greater.

The present course of the Missouri River is at the opposite side of the flood plain a mile or more distant. Until within a few years, however, the river flowed within a few hundred yards of the entrance of the cave. In 1881, the year of the highest water known in the river at this place since 1844, the water reached to within about seventy-five feet of the cave entrance, and to within twelve and a half feet of the

VIEW IN THE MOUTH OF THE TRIBUTARY VALLEY LOOKING OUT UPON THE MISSOURI BOTTOMS AND SHOWING THE ENTRANCE TO THE TUNNEL AT THE EXTREME RIGHT. From a photograph by Professor Chamberlin.

horizon of the skeleton, as determined from Mr. Martin Concannon's testimony.

The bones discovered in the excavation belong to two different skeletons. One of these skeletons is represented by a single bone, the left upper maxilla, belonging to a child about nine years of age, as determined by the teeth, of which the permanent incisors and first molar were fully erupted, while the deciduous molars were much worn. This bone was found about sixty feet from the entrance of the cave,

nearly upon the floor of the tunnel. The other skeleton was evidently complete, or nearly so, and but little disturbed. It was found about ten feet further away from the entrance, lying upon the limestone talus, though wholly covered by the silty material characteristic of the tunnel throughout. This skeleton is that of an adult between forty and fifty years of age, about five feet two inches in height, of slight build and, in much probability, of a female. The bones were firm, and as fully fossilized as could be expected in such material as enclosed them. The bones show in places an incrustation of a stony matrix commonly observed about bones of pleistocene animals preserved in river deposits in the west. I may also add that some of the bones of the leg show pathological deposits, probably rheumatoid. The young man who exhumed the skeleton stated that it was irregularly placed. As the specimen came under my observation it was largely enclosed in its original matrix. Very clearly it had not been covered by the limestone talus upon the floor of the cave. Portions of the encrusting matrix enabled one to determine that the bones had been in large part, if not wholly, articulated when discovered. Every collector of vertebrate fossils knows how rarely so large a skeleton as that of a man is found preserved entire and with the bones in position. The right femur was lying in its socket, but reversed; the left femur had been partly dislocated from its acetabulum, and was lying obliquely across the pelvis. Various other bones showed connections, and some of the bones of the feet are still united. Altogether, sufficient fragments were recovered to show that nearly every bone in the skeleton had been present. The femur measures a little more than seventeen inches in length (430 mm.), the tibia fourteen inches (350 mm.), the humerus twelve inches (302 mm.), the radius ten inches (250 mm.), and the forearm, from olecranon to wrist, eleven inches (277 mm.).

It seems very probable that the skeleton had been immersed in water while yet held together by the flesh. It is impossible that it could have been subjected to strong currents of water after the decomposition of the ligaments had occurred, nor could it have been exposed to the atmosphere for any length of time, nor even for a short time to the depredations of predatory animals while yet enclosed in the flesh. In other words, it seems almost beyond dispute that the person had either been thrown into the water very soon after death, or had been drowned, and that the body had remained immersed in comparatively quiet water until covered so deeply by the soil that it could no longer suffer the vicissitudes of exposure to the atmosphere and predatory animals. Evidences of artificial or accidental burial beneath the silt are wanting and are improbable. So far as any theory of the age of the skeleton is contradictory to this evidence it may be rejected.

Two chief views as to the age of the remains are now held: the one by Professors Winchell and Upham; the other by Professor Cham-

berlin, with the assent of Professors Salisbury and Calvin. To give all the reasons upon which these views are based is to repeat the already voluminous discussion, and we must content ourselves with the conclusions only.

According to Professors Winchell and Upham, the material covering the skeletons was deposited during the time of the fourth recrudescence or southward extension of the glaciers in the United States, in that stage known as the Iowan, that is, during the next to the last glacial extension which reached as far south as central Iowa. Under

VIEW FROM THE WEST SHOWING INTERSECTING TRENCH DUG TO JOIN THE ORIGINAL TUNNEL, with the Concannon residence in background. The skeleton was found nearly below the place indicated by the larger light spot at the right of the trees. From a photograph by Professor Chamberlin.

this view, the valley of the Missouri River was at this time filled to a depth of a hundred feet or more, but has since been excavated to its present level, and the material covering the Lansing skeleton is a part which has not since been carried away. In support of this view, it is claimed that the material covering the skeleton is of the character of glacial loess; that it shows evidence of water stratification; and that there is no evidence to prove that there has been any subsidence of the valley subsequent to glacial time.

The other view is that presented by Professor Chamberlin. He believes that the inhumation of the remains dates from a time when the river bed was from fifteen to twenty-five feet above its present level, that is, when the waters of the river eroded the surface of the limestone upon which the bones were lying, and that the bones themselves were covered by the action of the river, or by the wash from the adjacent uplands. The material above the stratum already described, Professor Chamberlin believes to be without evidence of water stratification; that it was built up chiefly by the action of the tributary, which deposited its washed down silt from the uplands upon the comparatively low gradient of the end of its valley, while the river itself was flowing at the opposite side of its flood-plain. He admits as possible, though less probable, that the whole of the material covering the skeleton may have been deposited by the action of the river while flowing at a high elevation. Whether his views are finally accepted or not, they are supported by valid arguments, and are conservative. By this explanation a considerable antiquity is accorded to our Lansing man, but one far short of the glacial times. If the other explanation is accepted, the one first offered by the present writer, and the one suggested as possible by Professor Chamberlin, the age of the skeleton would be considerably greater, though still much short of the glacial times.

Yet another opinion is held by certain able geologists—that the whole of the material covering the skeleton, and to the top of the knoll, full forty feet above the flood-plain, has been built up, for the most part at least, by the action of the tributary. This explanation might permit the inhumation of the skeleton within very recent times, since the settlement of the valley by white men, indeed. But, this view seems incompatible, not only with the physical conditions presented, but also with the evidence afforded by the skeleton itself, and is, I believe, untenable. This explanation would require the covering of the skeleton while yet in the flesh, by some sudden freshet in the ravine, so deeply as to be beyond the effects of the atmosphere, and the reach of the many prowling wolves and other predatory animals—a requirement that seems quite improbable, considering the position and condition of the skeleton. Such a freshet would be far more likely to wash the body or skeleton far out into the valley of the river.

Dr. Holmes has somewhat modified Professor Chamberlin's views, in that he believes that a change of level in the altitude of the river of five or ten feet would be sufficient to have met the conditions presented. However, Mr. Holmes frankly says that the decision must finally rest with the glacial geologists, none of whom has so far published anything to sustain the lessened estimate. Furthermore, Mr. Holmes' views are open to the same objections as those just given. It seems to me that nothing short of Professor Chamberlin's estimate will meet the paleontological requirements.

As to the character of the remains themselves, both Dr. Hrdlicka and Dr. Dorsey, to whom may confidently be left the final decision, assert that they are of modern type, and might well belong to an Indian inhabiting the plains region within quite recent times, so far as anthropological evidence goes. Nor does this verdict as to the character of the remains have much to do with either of the views presented. It is certainly not improbable that the widespread races of American Indians date back for thousands of years in their history. Mr. Upham's estimate of the time since the death of the Lansing man is about twelve thousand years, a not unreasonable time for the evolution of the American Indian.

Evidences of the high antiquity of man in America have hitherto been wanting, or doubtful, and the Lansing man, whichever age is assigned to him, can claim but little greater age than might be given him from *à priori* reasoning. One must frankly admit that proofs of man's contemporaneity with the many extinct animals of the pleistocene times in North America have been few, and perhaps in some cases doubtful. But, that man has existed with some of the large extinct animals of North America, the present writer, in company with other vertebrate paleontologists, believes. But this belief does not carry with it, necessarily, a belief in any very great antiquity. It seems very probable that some of these large animals, such as the elephant, mastodon and certain species of bison, have lived on this continent within comparatively recent times.

Furthermore, if the evidences of the commingling of human and extinct animal remains in South America are to be accepted, and such evidences seem almost beyond dispute, it must necessarily follow that man has existed on our own continent for a yet longer time, since there could have been no other way for him to reach the southern continent than through the Isthmus of Panama. In additional support of the evidence of man's high antiquity in South America, I am permitted to quote the following from a recent letter by Professor W. B. Scott, the distinguished paleontologist of Princeton University, who has recently spent some time in those regions in the study of the extinct vertebrate fauna: "I am convinced, from personal examination, that man existed in South America contemporaneously with the great, extinct mammals. To be more explicit, human remains have been found in the Pampean beds in association with large numbers of extinct mammalian genera." Is it not reasonable to suppose that we must seek for the earliest indications of man's habitation on our continent in the Pacific regions?

THE PROGRESS OF SCIENCE.

THE SMITHSONIAN AND CARNEGIE INSTITUTIONS.

THE regents of the Smithsonian Institution held their annual meeting on January 28, and the report of the secretary for the year ending June 30, 1902, has been made public. The first year-book of the Carnegie Institution is nearly ready, and will probably be distributed at about the same time as the present number of the MONTHLY. Those who are interested in science have, therefore, an opportunity to judge the work of these institutions, so unique in their objects and so great in their possibilities. The two institutions have many points of similarity in their organization and aims. The original bequest of Smithson, approximately $500,000, was about the same as the average endowment of the leading colleges at the time, and the $10,000,000 given by Mr. Carnegie is now about equal to the average endowment of our great universities. Each institution is managed by a board, which meets once a year at Washington and is composed of eminent citizens of the country. Each institution has an executive head, but lacks any body corresponding to the faculty of a university. There are, however, several points of difference. The Smithsonian Institution is concerned with the diffusion as well as with the increase of knowledge, and its activities are supposed to extend 'per orbem.' The Carnegie Institution is confined to the advancement of knowledge by research, and the founder has stated: 'That his chief purpose is to secure, if possible, for the United States of America leadership in the domain of discovery.'

The Smithsonian Institution has performed a service of immense importance, though probably not on the lines expected by the founder. What should be done with Smithson's bequest was for years a matter of debate in congress and elsewhere. When the institution was finally organized in 1846, it was the main center of scientific work in the country. Its 'establishment' was the president of the United States with his cabinet, the vice-president and the chief justice. The regents represented the executive, the supreme court, the senate, the house, the District of Columbia and different states. The secretary was keeper of the museum, librarian and practically the head of all the scientific work done at Washington. But in fifty years the scientific activity of the country has developed in a way that is without precedent. The incomes of our leading universities are twice the original endowment of the Smithsonian, and the national government spends annually on the geological survey or the weather bureau twice this endowment.

The Smithsonian Institution might conceivably have become a branch of the government coordinate with the executive, legislative and judicial branches, but the reverse of this has happened; its functions have become increasingly unimportant, and it probably now is a drag on the government agencies that it still administers. The establishment is a mere name; the regents meet annually for an hour or two to listen to the report of the secretary; there is no more reason why the secretary should continue as keeper of the national museum than as librarian of the national library. The last report of the secretary is certainly dis-

appointing. So far from recommending that the National Museum and the Bureau of Ethnology should be given greater autonomy, he proposes to administer at the expense of the government a national gallery of art and has abolished the office of director of the Bureau of Ethnology. The researches done by the institution proper are described in four lines. One memoir of an outsider and three compilations have been published. The only attempt to do anything for the diffusion of science is the reprinting (at the cost of the government) in the annual report of scientific articles from this and other journals, the sales of which in the preceding year amounted to $16.41. The international exchanges are supported by the government to the profit of the institution and, so far as they concern science at all, belong to the age of barter. It is of course easier to criticize than to outline a constructive policy. The regents will hold an adjourned meeting on March 11, when there will be opportunity for discussion of the administration of the institution. Most men of science would agree, if invited to give their opinion, that the National Museum and the Bureau of Ethnology should be given greater autonomy and that the Smithsonian Institution should be brought into closer touch with the scientific interests of the country.

Appreciation is far pleasanter than criticism, but we can not express unqualified admiration for the work of the Carnegie Institution as related in its first year-book. The trustees passed a resolution requesting the executive committee to prepare a report on the work that should be undertaken by the institution, but apparently no definite policy has been adopted. Advisory committees of scientific men were appointed, and their reports, as published in the year-book, give interesting suggestions as to the needs of science. The members of these committees were, we understand, paid from $100 to $200 and then discharged. Were eminent lawyers, engineers or physicians retained for services so important, their fees would be from $1,000 to $10,000. Under these circumstances it is not surprising that the reports are somewhat unequal, and no attempt seems to have been made to coordinate them. There were no general meetings to consider the policy of the institution. Thus the committees on physics and on geophysics recommended an annual expenditure of $400,000, apart from buildings, publications, etc.; yet they probably do not expect the entire income of the institution to be spent as they recommend. If there is any one point on which the various committees tend to agree it is that the scientific work and policy of the institution should be directed by experts, but no provision has been made for such direction. In place of any large plans for the advancement of science, the trustees have appropriated $200,000 for subsidies which have been allotted by the executive committee. The details of these subsidies have not been published, but, in so far as they have become known, they appear to be rather obvious. Grants for the Harvard, Lick and Yerkes Observatories are safe investments, but do not appeal to the imagination. The revival of the *Index Medicus* is a worthy undertaking, but such a drag-net of medical literature should be supported by the physicians whose cases it further advertises. Fortunately the institution has avoided any serious errors such as the assumption of ownership of the Marine Biological Laboratory on which an option was purchased by the executive committee. The well-meaning but rather colorless policy of the institution is adequately shown by the report of the president which we reproduce.

PRESIDENT GILMAN'S SUMMARY OF THE PLANS AND METHODS OF THE CARNEGIE INSTITUTION.

As a convenient summary of the plans and methods thus far agreed upon the following minute is approved:

The methods of administration of the Carnegie Institution thus far developed are general rather than specific.

The encouragement of any branch of science comes within the possible scope of this foundation, but as the fund, munificient as it is, is inadequate to meet the requests for aid already presented, not to mention others which are foreseen though not yet formulated, attention has been concentrated upon a selection of those objects which, at this time and in our country, seem to require immediate assistance.

Efforts have been and will be made to secure cooperation with other agencies established for the advancement of knowledge, while care will be exercised to refrain from interference or rivalry with them. Accordingly, ground already occupied will be avoided. For example, if medical research is provided for by other agencies, as it appears to be, the Carnegie Institution will not enter that field. Systematic education, abundantly provided for in this country by universities, colleges, professional schools, and schools of technology, will not be undertaken. Nor will the assistance of meritorious students in the early stages of their studies come within the scope of this foundation. Sites or buildings for other institutions will not be provided.

Specific grants have been and will be made, for definite purposes, to individual investigators, young or old, of marked ability, and for assistance, books, instruments, apparatus and materials. It is understood that such purchases are the property of the Carnegie Institution and subject to its control. The persons thus aided will be expected to report upon the methods followed and the results obtained. In the publication of results it is expected that the writer will say that he was aided by the Carnegie Institution of Washington, unless it be requested that this fact be not made known.

In order to carry out the founder's instructions in respect to bringing to Washington highly qualified persons who wish to profit by the opportunities for observation and research afforded by the various scientific bureaus of the United States Government, a certain sum is set apart for this purpose.

In addition, the Carnegie Institution will appoint from time to time a number of persons to be known as research assistants, who may or may not reside in Washington, and who shall undertake to carry on such special investigations as may be entrusted to them by the institution. The appointments will be made for a year, and may be renewed in any case where it seems desirable. Permission may be given to go abroad, if special advantages not accessible in this country can thus be secured.

Publication is regarded by the founder as of special importance. Accordingly, appropriations will be made for this purpose, especially for the printing of papers of acknowledged importance, so abstruse, so extended or so costly that without the aid of this fund they may not see the light.

With respect to certain large undertakings involving much expense, which have been or may be suggested, careful preliminary inquiries have been and will be made.

In order to secure the counsel of experts in various departments of knowledge, special advisers have been and will be invited from time to time for consultation. Valuable suggestions and counsel have already been received from such advisers.

SIR GEORGE GABRIEL STOKES.

In the death, on February 1, 1903, of Sir George Gabriel Stokes, the mathematico-physical sciences have lost one of their most eminent representatives. For sixty years he has been a leader in the British school of mathematical physicists, a school including as peers and contemporaries George Green, Sir William R. Hamilton, Sir George Airy, James Clerke Maxwell, Lord Kelvin and Lord Rayleigh.

SIR GEORGE GABRIEL STOKES.

Stokes was born at Skreen, County Sligo, Ireland, in 1819. He was educated at Bristol College, and at Pembroke College, Cambridge, where he was senior wrangler in 1841. He was elected a fellow of Pembroke the same year. In 1849 he became Lucasian professor of mathematics at Cambridge, and he held this position up to the time of his death. He served his college and university also in numerous other positions of honor, having been master of Pembroke for many years and a member of parliament for Cambridge from 1887 to 1892.

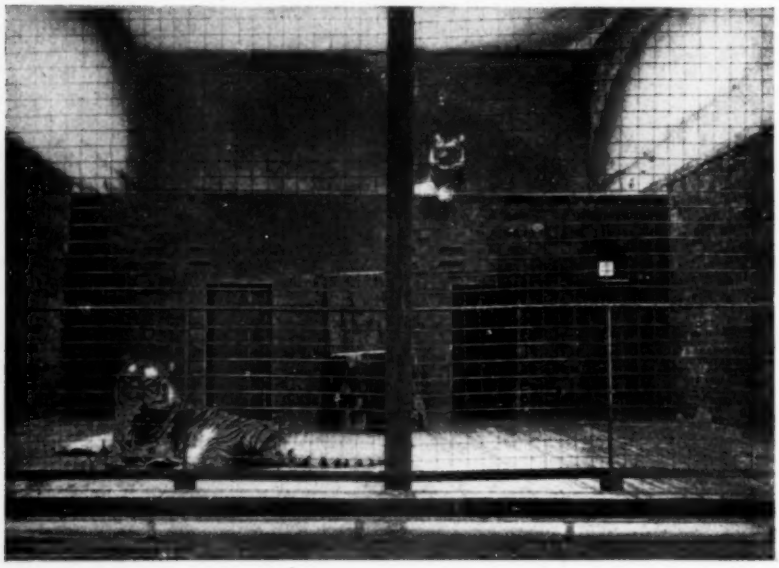
The fields of work to which Stokes devoted his attention chiefly are those of hydromechanics, including the theories of fluid motion and sound; the undulatory theory of light, including among his more recent papers researches on the X-rays; and physical

geodesy, including investigations on the figure and constitution of the earth and the variation of the acceleration of gravity at its surface. Taking up the work in these fields at the stage of advancement attained in the early part of the last century, mainly through the labors of the distinguished French investigators, among whom Lagrange, Laplace, Poisson and Fresnel were preeminent, Stokes contributed a large part of the decided progress gained during the past sixty years. He shares with Helmholtz the credit for the important advances in hydromechanics since the epoch of Lagrange; he did more than any other writer to extend the brilliant work of Fresnel; and his additions to the theory of geodesy are the most noteworthy since the epoch of Laplace.

His long and active career was crowned with recognition such as falls to few men of science. Universities and learned societies of his own and foreign countries conferred upon him the highest marks of distinction; while at the 'Stokes Jubilee,' celebrated at Cambridge in the summer of 1899, the whole scientific world united in presenting the heartiest tribute of appreciation of his laborious and fruitful life.

THE NEW YORK ZOOLOGICAL PARK

THE New York Zoological Park and Society have made important progress during the past year. We have already called attention to the fact that the New York Aquarium has been placed under the charge of the Zoological Society. The city appropriates $45,000 for the maintenance of the aquarium, while the society undertakes the scientific control. The importance of the aquarium as an educational institution is borne witness to by the fact that the average daily attendance is 5,000 persons. The new director, Dr. C. H. Townsend, has made a number of improvements in the aquarium. He has planned a fish-hatching exhibit, which will be in operation throughout the year, and alterations that will greatly improve the illumination and ventilation. He also proposes to bring the aquarium in closer touch with the



CAGE SHOWING BENGAL TIGERS.

school system of New York by providing material for biological classes and in other ways.

The Zoological Park has during the year greatly enlarged its buildings and its collections. The city provided $85,000 for maintenance, which is this year increased to about $105,000. The board of estimate and apportionment last year made a special appropriation of $250,000 for the improvement and extension of the park, which was used for the making of paths, etc., and for the construction of several buildings. The most important of these is the lion house, erected at a cost of $150,000. We give views of the interior of the main hall, which is 192 feet in length, and of one of the cages, which is 18 x 22 feet in size. It will be noticed that the cages are enclosed with netting instead of with bars. The cages are covered with glass tiling of a dull jungle green color, which forms an excellent background for the display of the animals and has many sanitary advantages. A unique feature of the building is a studio for artists, which will encourage painters and sculptors to make studies of animal life.

The lion house was opened in February; a new antelope house, costing $50,000, will soon be ready. The sum of $25,000 has been subscribed chiefly for the increase of the collections and valuable gifts have been received. The society pays special attention to scientific work, having established a pathological laboratory and appointed scientific curators in place of the usual keepers. The park was visited last year by 731,515 persons, in spite of its present inaccessible position; when the rapid transit system is completed, the attendance will doubtless be doubled or trebled.

MAIN HALL OF LION HOUSE.

SCIENTIFIC ITEMS.

WE record with regret the deaths of Dr. H. E. Schunk, F.R.S., the British chemist; of the Rev. Dr. Henry W. Watson, F.R.S., known for his contributions to mathematics and physics; of

Mr. James Winshurst, F.R.S., known for his work in electricity; of Dr. John Young, lately professor of natural history at Glasgow University; of M. Pierre Lafitte, professor of the history of science in the Collège de France; of Professor Leonard Landois, professor of physiology at Greifswald, and of Dr. Morrill Wyman, one of the best known American physicians.

THE Nobel prizes for 1902 were formally awarded on December 10—the prize in chemistry to Professor Emil Fischer, of Berlin; the prize in medicine to Professor Ronald Ross, of Liverpool University, and the prize in physics to Professor H. A. Lorentz, of Leiden, and Professor P. Zeeman, of Amsterdam. The value of each of the prizes is about $40,000.—The Desmazières prize of the Paris Academy of Sciences has been awarded to Professor Roland Thaxter, of Harvard University, for his study on the parasitic fungi of American insects.

PROFESSOR F. W. CLARKE, of the U. S. Geological Survey, has been invited to deliver the Wilde lecture before the Manchester Literary and Philosophical Society next year on the occasion of the celebration of the hundredth anniversary of the propounding of the atomic theory at Manchester by Dalton.—Dr. Edgar Smith, professor of chemistry in the University of Pennsylvania, has been elected president of the American Philosophical Society.—Commander Robert E. Peary, U.S.N., was elected president of the American Geographical Society, New York, at its annual meeting on January 27.—Sir William Turner, professor of anatomy, has been appointed principal of the University of Edinburgh.—Professor G. N. Stewart, of Western Reserve University, has been appointed professor of physiology at the University of Chicago, to fill the vacancy caused by the removal of Dr. Jacques Loeb to the University of California.

THE hundredth anniversary of the birth of Heinrich Daniel Rhumkorff was celebrated at Hanover on January 15. A tablet was placed on the house in which he was born and a new street was given his name. Professor W. Kohlrausch made an address on Rhumkorff's scientific work.—Mr. Carnegie has intimated to the provost of Greenock that he is prepared to present to a properly authorized authority in the town the sum of $50,000 to defray the cost of the erection of a memorial to James Watt.